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ABSTRACT

This packet contains the materials necessary for presentation of the eighth of ten modules that comprise a portion of the National Training and Development Service Urban Management Curriculum Development Project. This module focuses on productivity measurement which is the evaluation of the efficiency with which resources are consumed within the effective delivery of public services. The packet includes an instructor's manual which provides notes to assist the presentation of materials and a student/participant manual which introduces productivity measurement and case studies for the practical application of the concepts introduced. (Author/MK)

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PRODUCTIVITY MEASUREMENT

Instructor's Manual

Prepared by Dr. Elaine Morley

Module Number Eight
of
POLICY/PROGRAM ANALYSIS AND
EVALUATION TECHNIQUES Package VI

Developed by

CENTER FOR URBAN AND REGIONAL STUDIES
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TABLE OF CONTENTS

Page

INSTRUCTOR'S MANUAL PREFACE-- VI.8.ii
- Description of Instructor-- VI.8.ii
- Description of the Audience-------------------------------------- VI.8.ii
- Description of Setting and Resources Needed---------------- VI.8.iii
- Activities--- VI.8.iii
- Format of Instructor's Manual------------------------------------ VI.8.iii

INSTRUCTOR'S NOTES TO ACCOMPANY CHAPTER 1---------------------- VI.8.v

INSTRUCTOR'S NOTES TO ACCOMPANY CHAPTER 2---------------------- VI.8.vi
- Defining Productivity-- VI.8.vi
- Problems of Productivity Measurement in the Public Sector--- VI.8.vii
- Methods for Measurement of Productivity in the Public Sector--- VI.8.viii

INSTRUCTOR'S NOTES TO ACCOMPANY CHAPTER 3---------------------- VI.8.xv
- Establishment of a Productivity Measurement Program-------- VI.8.xv
- Gaining Support for the Productivity Program--------------- VI.8.xvi
- Productivity Bargaining------------------------------------ VI.8.xvii
- Costs and Benefits of Productivity Programs--------------- VI.8.xviii

INSTRUCTOR'S NOTES TO ACCOMPANY CHAPTER 4---------------------- VI.8.xix
- Selective Introduction--- VI.8.xix
- Choice of Productivity Measures---------------------------- VI.8.xx
- Quality of Public Services---------------------------------- VI.8.xxi
- Goals of the Productivity Program-------------------------- VI.8.xxi
- Studying the Production Process--------------------------- VI.8.xxi
- Methods of Improving Productivity------------------------ VI.8.xxiii

INSTRUCTOR'S NOTES TO ACCOMPANY CHAPTER 5---------------------- VI.8.xxiv

BACKGROUND PAPER-- VI.8.xxvii

GLOSSARY--- VI.8.xxxiii

BIBLIOGRAPHY-- VI.8.xxxv

Instructor's Manual
Preface

The introductory material presented in Chapter 1 of the Student Manual may serve as an introduction for the module instructor as well. Additional information useful for the instructor but not required for the student is presented in this preface.

Description of Instructor

It is desirable that the instructor have some familiarity with public sector productivity, although a prior thorough knowledge of the topic is not necessary. The instructor's knowledge of productivity could be based on classwork taken, work-related experience, teaching, research, or other exposure to the topic. It is suggested that the instructor read most of the material presented in the Instructor's Bibliography to enhance his or her understanding of productivity before leading the class. Readings in the bibliography that are felt to be particularly important are marked with an asterisk. It is strongly recommended that the instructor read Productivity in the Local Government Sector by John P. Ross and Jesse Burkhead (full citation given in bibliography). It is assumed that the instructor will have sufficient time and motivation to become completely familiar with the material presented in the student manual as well as with other material on productivity. This is essential to the successful teaching of materials included in the module.

While there is some mathematical material included in this module, it does not require advanced mathematical skill. An understanding of basic algebraic concepts is suggested to enable the instructor to present the material in a manner conducive to better understanding by the students.

Description of the Audience

The module material is designed for people employed in various managerial level positions in the state and local government sector, although others interested in public sector productivity could also be included. No particular prerequisites are set for class membership; it is felt that those interested in participating in the learning module will have an appropriate background to benefit from the learning experience offered. It is suggested that class members be drawn from a variety of agencies or departments. Class participation is felt to be a significant part of the learning experience; therefore, class members will be encouraged to share their experiences and problems in the area of productivity, and to help provide insights into situations faced by other class members. A diversity of backgrounds will enhance the quality of the learning experience afforded by class participation. Thus, if all or most class members were drawn from one agency or department there would not be sufficient variety in their experience and perceptions to provide the high quality learning experience desired.

A brief comment should be made on "behavioral objectives" or "learning objectives" of this module. Due to the nature of the topic, it is not possible to state these in clear, quantifiable terms. The module is trying to convey a basic understanding of the problems involved in public sector productivity measurement and some of the managerial concerns related to productivity measurement programs. However, it is difficult to quantify the concept of "basic understanding." It is felt that administration of a "quiz" for each chapter of the module is not appropriate for the audience intended or for the format used in the module. Some aspects of the module have more quantifiable objectives - learning how to use a particular mathematical model and how to a measure productivity change given certain data. "Success" in these aspects can be determined by performance on the worksheet provided in Chapter 2 and the case studies in Chapter 5.

Description of Setting and Resources Needed

Little is required in terms of setting beyond a meeting room of appropriate size. A blackboard is needed to aid in presentation of some material. The student manual suggests that participants will find hand calculators useful. The instructor may wish to have one or more "extras" available (depending on class size) in case some class members do not have their own calculator. However, it is not necessary that each participant have one; "sharing" is possible since most calculation will be done in the process of team problem solving.

Activities

As noted above and in the introduction to the Student Manual, the success of the learning experience is dependent on class participation and interaction. Much of this will occur in an informal, discussion oriented manner; some of it will be structured within a role-playing or case-study format. It is important that the instructor encourage class participation. If techniques not explicitly set forth here appear desirable in a given situation, the instructor should feel free to employ them. Discussion questions and suggested activities, such as role playing, for different parts of the module will be presented in the main portion of the Instructor's Manual.

Format of Instructor's Manual

The material presented in the Instructor's Manual will consist of guidelines keyed to material presented in the Student Manual. If the material is presented in a group format as opposed to being self-instructional, the student will not require the material presented in text form in the Student Manual. This material will instead provide the basis for lectures presented by the instructor and/or group discussion. However, the student manual should be presented to the student for further study or reference after the course is completed. Note that the instructor's manual does not provide outlines for lectures. It is expected that the instructor will prepare his or her own lecture material based on the material presented in the student manual and any other material (from the bibliography provided or elsewhere) that appears helpful in presenting the concepts included in the student manual. The instructor's manual should be read in conjunction with the student manual, as the former makes extensive reference to the latter, but does not generally repeat material presented in the student manual.

The remaining material presented herein will consist of suggestions to the instructor regarding points to stress or areas that may need particular care in explanation or clarification. In addition, suggestions will be given regarding potential discussion questions or topics and other activities to be performed as part of the learning experience. These suggestions will be grouped in conformance with the chapter sequence of materials in the Student Manual.

A "background paper" providing a general overview of public sector productivity measurement and the topics included in this module is appended to this manual. If desired, this background paper could be sent to participants who would attend group sessions on productivity measurement prior to their attendance at the session to provide some foundation for the material to be covered in the program.

Instructor's Notes to
Accompany Chapter 1

Chapter 1 is the introduction to the curriculum module. It is suggested that the instructor begin the curriculum module by introducing himself or herself and having each class member do the same. Class participants should also be asked to identify the department or agency with which they are associated and their position therein and to state the objectives desired from participation in this module. One useful "ice-breaking" technique for a situation where most people do not know each other and where participation is being encouraged is to have each person introduce himself or herself (identifying the aspects mentioned above,) to one person seated nearby. About 5-10 minutes should be given for the mutual introductions and conversation. After this, each pair of people will introduce each other (not themselves) to the group at large.

The instructor should then present the information included in Chapter 1. Class discussion could be initiated by asking the participants why they feel productivity is important. Particular emphasis should be placed on the importance of class participation, which is included in the section on instructional strategies. Further class discussion or questions regarding module objectives could be elicited. Time required for the introduction is approximately 30 to 60 minutes, depending on the size of the class. Time estimates are given prior to each chapter in the student manual, specified in terms of a time range. The estimates could vary from actual time used for a given session due to the size of the class and degree to which they participate (i.e., a large class that tends to participate considerably will probably come close to the maximum time estimate; a small, "quiet" group might not even require the low estimate.) Estimates also include time for breaks - in other words, it is assumed there will be a "coffee break" or rest break within each session. Time allowed for these is at the discretion of the instructor.

Instructor's Notes to Accompany Chapter 2

(Time estimated for Chapter 2 is 3-4 hours.)

The material presented in Chapter 2 is probably more important than any other in the module. This chapter is meant to define and clarify the concept of public sector productivity, and thus sets the framework for material presented afterward. Therefore, the instructor should be careful to determine that the concepts included in this chapter are understood by the participants. This chapter relies somewhat more heavily on lectures than the remainder of the module, but class discussion is to be encouraged in this portion as well.

Defining Productivity

The instructor could begin this portion of the module by asking the class how they would define productivity, and perhaps writing the various responses on the blackboard. The major point of this section, that productivity relates outputs to inputs, should then be stressed. The popular notion that productivity means "harder work" could be brought up and dispelled, if it has not been suggested in one of the student definitions.

Topics of particular importance in this segment include the notion of the production process - some class members may not initially understand this concept, and care should be taken to be sure it is understood before moving on. Relating the notion of productivity to other concepts of efficiency and differentiating "efficiency" and "effectiveness" are other points to be stressed.

The section focuses on general methods of measuring productivity in the private sector, with particular emphasis on labor productivity. The various ways of measuring labor inputs and differing interpretations of "productivity" as a result of using different measures might be somewhat confusing to class members. Therefore, these concepts should be gone over in some depth. A more detailed explanation of these concepts follows.

Labor inputs could be measured in a simple sense purely by the number of people employed. Assuming one person is employed and produces eight units of output in an eight hour day, the output/input ratio is 8/1. If the labor units were measured in labor-hours, the ratio would be 8/8, or one unit per hour. Now assume on a particular day the employee works overtime and produces one additional unit of output. If the labor unit alone is used, the ratio for that day will be 9/1, and it will appear that worker productivity has increased. However, if labor hours are used, the ratio will be 9/9, or one unit per hour, and it will be seen that productivity has not changed, but that the amount of input has varied as well as the amount of output.

Labor quality, or human capital, may also affect productivity since a more highly skilled or better educated worker may be able to produce more outputs in a given period of time than a less-skilled worker. Thus replacing the original worker with a "better quality" worker might increase output to ten per day, but the input measure would really not be the same because the units of input are not homogeneous. This problem may be dealt with by using earnings as "weights" to differentiate labor inputs. For example, if the first employee earned $20 per day and the second, $30, the respective ratios would be 8/$20 and 10/$30. Of course, in this example the output units could also be converted to dollar terms for the sake of uniformity and ease of interpretation.

It should also be made clear that changes in other inputs, such as equipment, may affect productivity. If productivity is measured in terms of labor only, such changes will be attributed to increased labor productivity, while they are really due to other inputs. However, if labor is the major input, the single factor indicator will provide a fairly satisfactory indicator of labor productivity. Total factor productivity is not as important a concept in terms of class understanding as is labor productivity, therefore a basic, rather than in-depth, understanding of the concept is required. That is, the class should understand that more than one input is considered when measuring total factor productivity. The mechanics of how this is accomplished are not of concern in terms of objectives of this module, however.

Problems of Productivity Measurement in the Public Sector

The material presented in this section provides background information essential to understanding public sector productivity measurement. It essentially explains why there is a problem in measuring public sector productivity by explaining how the public sector differs from the private sector. The service nature of the public sector should be emphasized and contrasted with productivity measurement in industries producing tangible outputs. The concepts of direct outputs and consequences (which may be referred to as D and C outputs) lends itself well to class participation and discussion. The instructor could ask the class (as a group) to suggest D and C outputs produced by the agencies or departments represented by the class participants. If there are few different agencies or departments represented, the instructor could suggest some to bring more diversity to the discussion. This discussion would also bring out clearly the multiple objectives to be found within public sector agencies.

The concepts of efficiency and effectiveness and the differences between them presents another topic for discussion - examples of the differences between these concepts and how they might be measured could be elicited from the class, perhaps with respect to some of the outputs suggested in the previous exercise. Sets of corresponding D and C outputs could be chosen, and the class could suggest ways of measuring efficiency (with respect to the D output) and effectiveness (with respect to the C output).

Methods for Measurement of Productivity in the Public Sector

A major point to be stressed before discussing various methods used to measure public sector productivity is the lack of agreement upon one "correct" method to do so. The method that should be stressed as preferred for use in those cases where use is possible is the ratio of outputs to inputs. However, this section provides an overview of other methods that have been used, and outlines advantages and disadvantages of each.

The simple approaches to productivity measurement presented here (outputs or inputs alone) should present no problems in terms of class understanding. After each measurement technique is explained, the instructor could ask the class to suggest the advantages and disadvantages associated with the method, and then supply those noted in the manual that the class may have missed.

The approach of using improved management techniques and/or money saving measures may require a few examples to indicate the types of activities that might be included. Some examples are:

1) Keeping an adequate inventory of supplies in garages repairing sanitation trucks to reduce the "down time" of trucks needing repair.

2) Paying bills promptly to take advantage of vendor discounts.

3) Changing scheduling systems to increase the percentage of work force available when work loads are highest.

4) Purchase of new equipment and/or new capital facilities.

The discrepancies between some of these concepts and productivity measured in terms of output/input should be stressed. However, it should also be emphasized that improvements in management techniques are desirable, and some may lead to productivity improvement in the output/input sense.

The fiscal approach to productivity measurement utilizing components of expenditure change as proxies for productivity measurement is the most complex approach presented, as well as the one least likely to be familiar to class participants. The steps shown in developing the model involve simple algebraic concepts and the insertion of terms defined within the sequence in place of the terms as originally defined. This model should be presented on the blackboard and care should be taken that the changes occurring in each stage are understood. (An explanation of the steps follows). While it is desirable that the class understand the steps in development of the model, this is largely to "demystify" it. If it cannot be grasped fairly readily by some class members, this should not be a point of major concern. The model may still be used by simply "plugging in" appropriate values for the variables of the model as expressed in equation 6. However, the students should have a clear understanding of what the symbols represent. The numerical example given in Chapter 2 should be "worked through" by the instructor to show how the model operates with data. Worksheet 1 (at the end of Chapter 2) should be distributed to the class after the discussion of the model has been completed (i.e., after all material included in Chapter 2 is covered). and the two examples therein may be calculated individually by class members. A "pocket" calculator would be useful for this exercise - if not all students have one, some "sharing" may be necessary, which would lengthen the time required. The exercises should take approximately 15-20 minutes each. The "correct" answers should be verified by the instructor, who should determine whether any difficulties were encountered in solving these problems.

The fiscal approach utilizes proxy measures to represent changes in cost and workload to account for some of the change in total expenditure. The residual term generated by the model includes other factors that influence expenditure change - namely productivity, quality, and an error term. The steps in the model will be presented in detail here to enhance the ability of the instructor to present the model in a classroom setting.

The basic equation and definitions are presented on page VI.8.12. These should present no difficulty, and are formulated so the model may be developed further. On page VI.8.13, the first equation:

$$1)\quad E_2 = R^* + P(E_2)$$

is simply a rearrangement of Definition 2. The second equation uses the definition of E_2 given in #1 in expanding ΔE:

$$2)\quad \Delta E = E_2 - E_1 = R^* + P(E_2) - E_1$$

The third equation is a restatement of Definition 1 from the previous page:

$$P(E_2) = E_1 \left(\frac{C_2}{C_1}\right)\left(\frac{W_2}{W_1}\right)$$

with the values developed in Definition 3 for cost and workload ratios inserted:

$$3)\quad P(E_2) = E_1\ (1 + \Delta c)(1 + \Delta w) = E_1 + E_1\ (\Delta c + \Delta w + \Delta c \Delta w)$$

The fourth equation inserts the above expression for $P(E_2)$ into the equation for ΔE. In doing this, one of the "E_1" terms is subtracted:

$$\begin{aligned} 4)\quad E &= R^* + E_1\ (\Delta c + \Delta w + \Delta c \Delta w) \\ &= R^* + E_1\ \Delta c + E_1 \Delta w + E_1\ \Delta c \Delta w \end{aligned}$$

The third and fourth equations provide the cross product term, $\Delta c \Delta w$, that is partitioned in equations 5 and 6. Equation 5 is an identity equation because the terms in the brackets equal 1. The expanded expression for E_1 ($\Delta c \Delta w$) is inserted into the expression for ΔE developed in equation 4, providing the final equation.

$$5)\quad E_1(\Delta c\Delta w) = E_1\ (\Delta c\Delta w)\left[\frac{|\Delta c|}{|\Delta c| + |\Delta w|} + \frac{|\Delta w|}{|\Delta c| + |\Delta w|}\right]$$

$$6)\quad \Delta E = R^{*} + E_1\left[\Delta c + \Delta c\Delta w\left(\frac{|\Delta c|}{|\Delta c| + |\Delta w|}\right)\right] + E_1\left[\Delta w + \Delta c\Delta w\left(\frac{|\Delta w|}{|\Delta c| + |\Delta w|}\right)\right]$$

The explanations provided for various steps of the model in the student manual should be carefully studied. The model essentially tries to separate the portion of change in expenditure that may be attributed to cost and workload both individually and as they affect each other. This is done in the two terms in brackets in equation 6, and is the most complicated aspect of the model. This careful determination of the portion of change attributable to cost and workload is important in determining the best estimate of the residual value. The latter is of primary importance because it is this term that is felt to reflect productivity change. The numerical example provided should serve to show that the model can be utilized without need for higher mathematics, since only the insertion of a few easily calculated numbers is required to determine values for the portion of change attributable to R*, cost and workload.

The next stage in this approach is explaining how productivity is shown by the model. As Chapter 2 indicates, this cannot be readily determined. The instructor should make sure the class understands that the direction of R* (positive or negative) indicates probable increases or decreases in quality and productivity. A major point to be made here is that some attempt should be made to find indicators of quality or productivity to clarify the changes indicated by the model. Class discussion should be initiated regarding potential proxy measures to seek out, particularly in terms of quality indicators. Some examples follow: ratio of employees to "clients," such as teacher/pupils for education, or caseworker/welfare recipient for social services. Obviously, this quality indicator is not applicable to all government services. The ratio of population served to potential population might serve as a quality proxy-for example, the number of welfare recipients compared to the number of people below the poverty line. The quality of materials used may also serve as a general quality proxy when this can be ascertained, as could changes in "quality" (human capital) of employees. However, the latter may be particularly difficult to estimate in many instances.

It should be emphasized that the difficulty in interpretation is a major drawback of the model. However, it may be useful in performing a review of all agencies or departments to determine which ones may have had productivity decreases and should be studied further, a point which is also brought up in the next chapter. It is also useful in cases where no output or input data are available. It should be made clear to the class tht this approach is not being offered as the preferred method to measure productivity - more time is spent on it because it is a more complex approach than the others studied, not because it is the "best" approach.

The above concludes the measurement section of this curriculum module. The instructor may choose to recap the main points of this chapter at this time - either in the form of a brief review, by questions and answers, or by asking the class members to volunteer points they consider of prime importance.

Worksheet 1

Using the equations shown below, calculate the proportion of expenditure change attributable to cost, workload, and quality/productivity for the following two cases:

$$P(E_2) = E_1 \left(\frac{C_2}{C_1}\right) \left(\frac{W_2}{W_1}\right) \qquad R^* = E_2 - P(E_2)$$

$$\Delta c = \frac{C_2}{C_1} - 1 \qquad \Delta w = \frac{W_2}{W_1} - 1$$

$$E = R^* + E_1 \left[\Delta c + \Delta c \Delta w \left(\frac{|\Delta c|}{|\Delta c| + |\Delta w|}\right)\right] + E_1 \left[\Delta w + \Delta c \Delta w \left(\frac{|\Delta w|}{|\Delta c| + |\Delta w|}\right)\right]$$

Note: In performing calculations, decimals should be rounded at the fourth or fifth place (i.e., .ooox), where applicable.

Case 1:

Total expenditure in the initial time period was $1,000; in the terminal time period it was $1,800. The cost index ($C_2/C_1$) is 1.6, the workload index (W_2/W_1) is 1.1.

Case 2:

Total expenditure in the initial time period was $1,000; in the terminal time period it was $1,500. The cost index is 1.3; the workload index is 1.2.

Answers to Worksheet 1

Case 1:

$P(E_2) = 1760$; $R^* = 40$

$\Delta c = 0.6$ $\Delta w = 0.1$

Percent of change attributable to each component:

R*	C	W
5.0	81.4	13.6

Case 2:

$P(E_2) = 1.560$ $R^* = -60$

$\Delta c = 0.3$ $\Delta w = 0.2$

Percent of change attributable to each component:

R*	C	W
-12.0	67.2	44.8

The residual term accounts for about 5 percent of total change in the first case. If all of the residual is attributed to productivity, this would indicate a reduction in productivity has taken place. However, it is also possible that an improvement in quality has occurred, or some combination of the two possibilities. Without further information, nothing more certain can be determined. The second case shows a negative residual term, which indicates the possibility that productivity improved in this instance. However, a quality decrease or combination of factors could also be the explanation in this case.

ENDNOTES

1. The methodology presented here and its explanation is drawn from: John P. Ross and Jesse Burkhead, Productivity in the Local Government Sector (Lexington, Mass.: Lexington Books, 1974), pp. 101-108.

INSTRUCTOR'S NOTES TO ACCOMPANY CHAPTER 3

The material presented in Chapter 3 focuses on organizational and managerial aspects of productivity programs. As stated in the student manual, the topics covered in this chapter have received relatively little (if any) attention in the literature on public sector productivity. Thus the material included in this section cannot be viewed as established or accepted procedure concerning management or organization, but should be viewed instead as a tentative list of major points and potential problem areas to be considered and possible methods of managing them. Because of the tentative nature of much of the material included in this chapter, encouraging discussion and opinions from class members is particularly important. The familiarity many of the students have with local government management and organization may help to clarify or add to the topics covered in this chapter. Estimated time for this material is 2-3 hours.

Establishment of a Productivity Measurement Program

This section focuses on organizational concerns in setting up a productivity measurement unit. The instructor should introduce the basic topic and emphasize the probable need for a two-tiered organizational approach (i.e., both centralized and agency-level productivity offices would generally be required). The instructor should try to bring out most of the points included in this section (e.g., the functions of the productivity office), by use of questions and discussion. One of the most important aspects to be covered herein is that the choice of organization level for the productivity program has potential for affecting the power distribution within the individual agency or among the centralized city offices. This might not be a major consideration from a strictly managerial point of view, but would be of considerable importance when viewed from a political perspective. Since city government does involve political perspectives, the potential power changes involved in locating a productivity office are likely to be of more importance when dealing with the public sector than when dealing with private sector productivity. Therefore, the potential power redistribution and ways to deal with it should be a topic for class discussion, although it should be emphasized that there are no established "answers" as to how to deal with the problem, or with respect to where a productivity program "should" fit in the organizational scheme.

The matter of staffing should be briefly discussed. Again, the class might be asked how they would go about providing the staff-what things they would consider in doing this - to see if points included in the manual could be brought out by the students.

Gaining Support for the Productivity Program

This section deals with several aspects related to gaining support, but its major focus is on labor-management relations. It is important to emphasize one of the points made early in the section, namely that care must be taken not to "over sell" the productivity program. Class discussion on public relations approaches to gaining support for the program could be initiated at this point.

This section also deals with a topic that has received relatively little study in relation to public sector productivity. It should be pointed out that the emphasis of this section is not on union-management relations; this will not be discussed here although the topic of productivity will be considered in the next section. Much of this section deals with ways of introducing and carrying out productivity programs in a manner that generates employee support and cooperation, or, at least, avoids employee resistance. In this section also, many of the topics discussed in the student manual should be brought out in class discussion or by questions.

A considerable portion of this section deals with how productivity improvement programs might affect employee job satisfaction. A greater understanding of the factors affecting job satisfaction might be brought out by role-playing. Two different role-playing situations might be utilized--either or both could be used in any given class situations although use of both would be preferred.

Both role playing situations would have class members taking the role of "rank and file" public employees--policemen, firemen, social service caseworkers, clerks in central administrative offices, etc. They would be arranged in small groups (2 or 3 members) where all members of the group would hold the same position (i.e., all participants in one group would be firemen, for example). The members of the respective groups would then engage in discussion, expressing the thoughts and feelings they believe would be expressed by people in the employment roles they represent. It should be made clear to the participants that they should not try to role play in the image of stereotypes or extremes. They should simply try to adopt the frame of mind they feel the average police officer, social worker, or other public employee role assigned to them is likely to have and then express the feelings of this person in the exercises that follow.

One or both of the following role-playing discussions could be utilized. Class members could switch roles for the second discussion if both are used. The role playing situation that can be "imagined" is that the employees are talking during a coffee break on the job. 1) The students could be asked to discuss what it is they (in their employee roles) like about their jobs--those things that affect their job satisfaction. 2) The students can be told that a new productivity improvement program has been announced by City Hall. They should be asked to react to this announcement by talking it over with their "co-workers". About 15-20 minutes should be allowed for each of these role-playing situations. The "results" obtained in each group should then be expressed to the class as a whole. For example, the group representing policemen in the first role playing discussion might state specific elements related to job satisfaction. Responses to this role playing situation have brought out the following aspects of job satisfaction; respect, power, independent work, sense of importance, variety, job security, pay, and benefits. The instructor could then ask the class as a whole to try to express these in more general terms (e.g., control over job, independence, recognition, etc.). A list of elements of job satisfaction from the various groups could be put on the blackboard as the class discussion progresses. The end result is a better understanding of what factors affect job satisfaction.

After the second role-playing discussion, the reactions of the "employees" can be reported to the class as a whole and listed as discussed above. This list will indicate how a productivity program is perceived as affecting public employees by the employees themselves, and may be related to how it affects job satisfaction as expressed in the first role-playing. Responses to this situation in a previous role-playing group included: more work; more paperwork; more supervision; "they" won't know how to measure productivity for this job; what happens to pay? to security? The intent of the role playing discussions is to have the students achieve a greater understanding of the elements influencing job satisfaction and the fears related to loss of job satisfaction that may arise as a result of introducing a productivity program. If all of the topics mentioned in Chapter 3 are not brought out in the role-playing, the instructor should add them to the lists generated by the class. The class should then go on to discuss ways of implementing a productivity program to alleviate the employee concerns expressed in the role-playing. The instructor should guide this discussion and add any methods included in Chapter 3 that the students might not bring up.

The topic of political and citizen involvement follows employee relations. The importance of this and ways of achieving it could be brought out either in a short discussion or lecture by the instructor. The last subject of this section, gaining information from others, should not be overlooked. Class members might be asked what kinds of formal or informal information networks they typically use (or know about) in their own location that might prove useful in getting information or assistance related to a productivity program.

Productivity Bargaining

Although employee relations were discussed previously in terms of maintaining job satisfaction while introducing a productivity program, this section deals with the specific problem of productivity bargaining. The topic of productivity bargaining is complex, and this section is intended to highlight one aspect of major concern to management: that there should be awareness that costs agreed upon in a contract could exceed potential benefits derived from productivity gains unless care is taken to avoid such a situation. In particular, changes in work rules designed to bring about productivity gains may not result in such gains, and higher costs may be incurred in such cases without offsetting productivity improvement. Thus thorough exploration of changes proposed in a collective bargaining situation should be undertaken by management before the changes are agreed upon in negotiations.

Costs and Benefits of Productivity Programs

A major point to convey in this section is that costs associated with productivity programs might tend to be overlooked while the program is being introduced, but that these should be given careful consideration. Class discussion can be utilized to bring out some of the major costs that might be encountered including those related to the measurement stage of the program alone, and the potential costs of employee dissatisfaction. One major consideration is whether productivity improving methodologies or equipment can be afforded, and whether it would be worthwhile to undertake productivity analysis if they cannot.

INSTRUCTOR'S NOTES TO
ACCOMPANY CHAPTER 4

The final chapter of the student manual introduces some of the procedural steps involved in introducing a productivity measurement program. It also leads the discussion beyond the productivity measurement stage by inquiring about the eventual goal of the productivity program. This, of course, is to improve productivity. The chapter includes an introduction to a measurement technique that serves to familiarize the manager with the production process involved in providing various services as well as enhancing the ability to analyze the service in a way intended to lead to changes designed to improve productivity. Finally, an overview of common methods of improving productivity is provided. The topics included in this chapter should serve to help the manager deal with aspects of implementing the productivity program and also to introduce concepts with which the urban manager should be familiar when dealing with productivity programs. The material in this chapter should be introduced with use of considerable class discussion and participation, although the instructor will need to use the lecture format to teach some concepts included herein. Estimated time for this chapter is 2-3 hours.

Selective Introduction

This section is concerned with limited implementation of productivity programs; that is, introducing programs in only a few city agencies as opposed to "across the board" implementation. Class discussion could be utilized to bring out reasons why a limited approach might be desirable.

Two major reasons for selected introduction of a productivity program are discussed in this section. First, it may be used to overcome doubts or resistance. In this case, agencies selected will be used as a "showcase," and it should be emphasized that care must be taken in selecting agencies that will provide successful results. The second reason is that financial limitations may not allow extensive productivity measurement and analysis in all agencies at once. In this case, the proposed course of action is to introduce productivity programs in agencies that appear to be in greatest need of improvement. Such agencies can be selected by use of the fiscal analysis approach to productivity measurement which was explained in Chapter 2 of the Student Manual. This analysis can be performed fairly easily and at relatively low cost for all city agencies because it utilizes data that should be readily available for all agencies. Those agencies that appear to have had productivity losses (and/or lower than average gains) according to this model may be selected for further analysis and attempts to improve productivity. The instructor should point out that this is one of the best uses to which the fiscal analysis model can be put in the local government setting.

The instructor should make clear that the discussion of limited implementation of productivity programs is not meant to imply that this should be the standard approach to productivity introduction. This approach is suggested for use under circumstances which are not favorable to introduction of a full-scale program, and this point should be understood by the class.

Choice of Productivity Measures

This section deals with selecting the measures to be used in the local productivity program. Several topics related to choice of indicators are covered. The instructor might wish to approach this topic by asking the class how they would go about selecting indicators, and then supplying any concepts included in the manual the class might not have suggested.

It is important to stress that measures selected should be related to the goals of a given agency, but that they must also be quantifiable. In general, direct outputs (activities) will meet this description. However, care should be taken that activities of a final nature are selected, as opposed to intermediate activities. This section also brings out the general need for multiple productivity indicators to realistically appraise the performance of most service agencies. However, it should be stressed that restraint is needed in the selection process--too many indicators may be overly confusing in the long run. One could easily imagine an agency with several indicators showing varying degrees of productivity improvement, and several showing varying degrees of worsened productivity. In such a case, nothing meaningful can really be ascertained about performance in the agency as a whole. Thus only those indicators most closely related to major agency goals should be selected whenever possible.

The next aspect of measurement covered is quantification--or the form of measurement used. As noted in Chapter 2, the ratio of outputs to inputs is preferred. In most studies, labor is used as the input measure. Ideally, only the labor directly related to the activity should be measured, which would include portions of supportive staff associated with the activity. In most cases, however, measurement of the latter would be extremely difficult, at best, and it would generally be left out of the input measure. Thus one might have "arrests per patrolman" as an indicator, where use of patrolmen as the input is more closely related to the activity involved than total police department employment, which is an alternative input measure. The instructor may wish to review the problems associated with use of labor as an input measure that were covered in Chapter 2. Problems associated with use of expenditure as an input are also covered in this section.

A major point in selecting indicators is also brought out--namely that one is restricted by current data gathering techniques in the short run. If the current or past year is desired as the base by which future changes will be calculated, then current data collection practices will have a strong influence on choice of indicators. If one waits until data collection methods can be changed, then the base year will be in the future--perhaps the next fiscal year--which means no productivity changes from that base can be calculated for at least two years from the present (assuming that yearly intervals are utilized in calculating change, which is common practice). Thus the manager may have to accept the restrictions imposed by current data gathering in order to be able to perform analysis of productivity changes in the relatively near future.

The problem of locating and compiling available data is also discussed, with suggestions about what is likely to be available and where it might be found. The instructor might cover this aspect of the section by asking the class what types of statistics they think they could find for various services in their own government unit, where they might be found, and how easy it would be to obtain them.

Quality of Public Services

This section covers two aspects of service quality. First, it stresses the importance of keeping service quality constant while measuring productivity change in order to have an indication of the real productivity change. The major portion of the discussion of service quality, however, relates to changes in service provision intended to improve productivity. The main idea is that the general concept of quality incorporates a variety of aspects related to service provision, and that, ideally, service quality should not be allowed to deteriorate in an effort to improve productivity. Of course, in some cases it may not be possible to avoid this, or it may be decided that a particular trade-off between quality decrease and productivity increase is acceptable.

The instructor should point out that attempts to measure the various quality indicators listed will serve to further complicate the productivity measurement program. Under ideal circumstances, one would want to monitor this aspect of service delivery. The best compromise might be to attempt to initiate quality measurement only after the productivity measurement program has been in effect and its measurement system appears to be working smoothly. However, as long as the quality aspect is recognized by management, efforts can be made to informally consider possible quality impacts of changes designed to improve productivity, and attempts to avoid quality deterioration can be stipulated as major goals of the productivity program. This sensitivity to quality considerations on the part of urban managers should help avoid negative quality impacts from productivity programs.

Goals of the Productivity Program

This section really serves to introduce the remaining topics. Basically, it points out that productivity measurement is not undertaken for the sake of measurement, but that the end goal is to improve productivity. Toward this end, measurement is needed to locate the initial position and chart progress toward goals, and/or to discover problem areas.

Studying the Production Process

The purpose of this section is twofold. First, it shows that the process by which services are supplied must be understood in order to find methods of improving productivity. Second, it provides a framework for analysis of the production process.

The use of the operation process chart is explained in this section as a means to understand the production process better and as part of an analytic methodology for improving productivity. Since few class members are likely to be familiar with this, the process chart should probably be explained in a lecture format. After this, class discussion should be generated regarding the use of the process chart to study the production process for a few services to be sure that the concept is understood. Services represented by some class members might be selected, or the instructor could suggest services--preferably starting with a relatively simple service (such as trash collection). (It should be noted that this type of exercise is also included in the case studies in the next chapter, so the instructor should limit the number of examples here to those necessary to illustrate the process.) The way the service is produced should be examined in terms of personnel and equipment required to perform the service and the processes or activities performed in providing the service. For example, refuse collection may require one truck and a crew of three for each route: the driver and two other workers (the number may vary by location). The service is performed by the driver driving the truck along the route and stopping at each house or designated pick-up point. The other two workers pick up full refuse containers at the designated stops (which might mean curbside or back-door pick-up, varying according to the city involved), empty refuse into the truck, return empty containers, and proceed to the next stop.

The "Analysis of Activity Form" is offered in this section to show a systematic approach to analyze each step in the process chart. Each activity should be considered with respect to its appropriateness and how it is performed. Alternatives should be considered, and if one of these appears to improve productivity, the production process should be modified to incorporate it (assuming other factors do not prohibit the change). This analysis cannot be carried out without first decomposing the stages in the production process, however.

By first understanding steps involved in provision of a service, one can explore means of improving productivity. One can ask whether it is necessary to have two sanitation workers pick up the refuse, or whether one alone would be sufficient, or whether a different type of truck could be used that would hoist particular types of containers automatically, requiring only a driver. One could ask whether back door pick up should be eliminated in favor of curbside pick-up, or whether residents should be required to place trash in plastic bags as opposed to other types of containers, thus eliminating the "empty and replace container" phase of the operation. These modifications all might be considered as means of improving productivity, but they cannot be contemplated unless one is aware of what is involved in producing the service. The instructor should have the class (as a group) "work through" the analysis form for some of the activities on one of the previously constructed process charts, answering the questions and suggesting alternatives.

The subject of responsibility for gathering the production process data needed for preparing process charts as well as for the actual chart preparation should be discussed. This should be related back to the earlier discussion of the appropriate organizational level from which a productivity program should be directed and the necessity of gaining employee cooperation. The question of responsibility for the analytic phase should also be discussed. This could be done at either the centralized or decentralized level, or perhaps with a combination of representatives from each level. It seems clear that someone familiar with the service and how it is provided would be able to respond to some of the questions on the analysis form better than someone unfamiliar with the activity. Similarly, the person familiar with the service might be more able to assess the feasibility of alternatives, although someone less familiar with the service might be able to suggest different alternatives from a fresh perspective. Thus, it would appear that activity analysis might be best performed on some kind of group basis.

Methods of Improving Productivity

This section is related to the preceding section in that it offers broad suggestions for improving productivity that might be considered as alternatives to current production methods. It should be stressed that the analytic process should highlight potential areas where work rule or production method changes could be made to enhance productivity. The instructor might ask the class to think of work rule or procedural changes that might increase productivity in the agencies in which they work.

The topic of technological change and its relationship to productivity is somewhat more complex than the above. The substitution of new equipment for labor is the area that is likely to encounter the strongest resistance on the part of employees. This matter and ways of dealing with it, perhaps by retraining employees for different jobs, should be discussed. In addition, the costs of introducing technological innovations are likely to be quite high, especially compared to procedural changes. Thus the matter of costs and benefits should be brought up again here. There is also the problem of knowledge regarding new technology or innovations. Few local governments (if any) can afford research and development along these lines, and it may be difficult to keep abreast of new developments in this area. The topic of information networks brought up in Chapter 3 might be introduced here with respect to keeping informed about technological change.

The matter of employee acceptance of changes in work rules or introdcution of technological change is briefly mentioned in this chapter. Reasons for resistance are similar to those previously discussed with respect to productivity programs in general. However, the topic of employee incentives used to encourage acceptance of productivity improvement measures is outlined here. This is done to provide one idea of how productivity improvement might be managed by local government. Greater detail is not offered here since productivity improvement techniques are really beyond the scope of this module.

INSTRUCTOR'S NOTES TO ACCOMPANY CHAPTER 5

Chapter 5 of the student manual presents materials to be used in performing productivity measurement case studies. If the manual has not yet been distributed, it should be given to participants now. However, they should not consult the answer sheets until the cases are completed. The case studies should be performed by small groups (3-5 people, depending on the size of overall attendance), working jointly. The tasks to be performed are outlined in the student manual. The instructor should work closely with the groups as they work on the case studies, spending time with each group, participating in their discussions and guiding them back "on course" if there discussion gets "off the track." For a large group, it may be desirable to have an assistant, otherwise the instructor working alone would not have sufficient time to spend with each group.

Information in the case studies is presented in the form of 1960 and 1970 "annual reports" for the police, fire, and sanitation departments of "River City." There is also a brief description of population characteristics of River City. The groups are to assume they are members of a city-wide "productivity measurement task force" with goals of establishing an on-going productivity measurement program as well as assessing, insofar as possible from available data, the productivity change in these three departments over the 1960-70 decade. For reasons of time, it may be decided that all three case studies should not be worked out. Since the case studies are scheduled to take up the second day of the workshop, a considerable amount of time could be saved by performing only one of them, or perhaps by performing only some of the activities suggested for each. In case of the latter, it is strongly suggested that the productivity measurement portion of the exercises be included, even if no other elements of the case studies are incorporated. The actual measurement of productivity change provided by the case studies is an integral part of the learning experience, and should not be omitted. Of course, it is preferable that all three case studies are completed.

The first part of the case study involves defining the organizational location and functioning of the productivity measurement program. Topics to be considered in this part of the case study should include:

1. Where should the city-wide coordinating office for the program be located? Should a new "office" be created, or should productivity measurement be added to the functions of an existing office or department? Should outside consultants be hired?

2. Questions included in #1 should be considered again in terms of locating the program within each agency.

3. Who will determine what type of data will be collected for productivity measurement?

4. At the agency level, who will be responsible for collecting statistics needed for productivity measurement?

The second part of the case study is planning how the productivity measurement program should be introduced. The intent here is not to make a specific plan for introduction, but that there should be a discussion of the problems of introducing the program and a general outline of the introduction should be prepared. The major considerations in introducing productivity measurement revolve around labor/management relations and potential employee resistance, as discussed in Chapter 3. The focus of discussion should be on these areas. It should be noted that no "correct answers" are provided for this part of the case study--the intent here is to stimulate discussion in a realistic setting.

The third part of the case study involves determining whether or not productivity in the three departments improved between 1960 and 1970. The instructor may wish to have the class work with the sanitation department case study first, as it is the simplest one to measure. Possible measures for this and the direction of change they indicate are given for each department on the answer sheets provided. Productivity measurement for each department will be approached in two ways. The fiscal analysis method will be applied to get an indication of overall productivity change for the department. In addition, output/input measures should be calculated for the quantifiable outputs shown in relation to either labor or expenditure inputs. The results obtained from the different types of productivity measurement should be compared to see if consensus is reached on the likely direction of productivity change in each department. It is not suggested that the measures included here are the only appropriate ones; class members might find other acceptable indicators. However, the ones included here are major indicators that should appear fairly obvious to those participating in the study. Therefore, if they are not included in the measures of a particular group, it may indicate they did not fully understand some aspects of the material included in this module. Thus the instructor should pay careful attention to the selection of indicators by each group of participants.

The production process for each service should be outlined in general terms, as it is unlikely the participants have a thorough knowledge of each agency included in the case studies. Therefore, major elements of service provision could simply be stated in order of performance. A list of such elements is included on the answer sheets as a guide; additional elements might emerge in group discussion.

The final part of the case study involves stipulating the type of data that should be collected for future productivity measurement. This should be done for each service listed for the respective departments. Measures for activities not listed may also be included. Again, no "correct" answers have been provided for this part of the exercise. However, the instructor might point out that the students should consider both output and input measures in stipulating future data collection.

After the individual groups have finished their assessment of each department, they should present their findings to the class as a whole to obtain class feedback concerning their procedure and results. Discussion and feedback could occur after each case is finished, or for all three cases at once. The instructor should provide the solutions given in the answer sheets--which should not be used by the class during the exercise. A major goal of this exercise is to show the problems and frustrations involved with attempting to measure productivity change on the basis of generally available data. The class should become very aware of this as they work through the case studies. There are few incidents in the case studies where the direction of productivitiy change shown by the various indicators are unambiguous. This is likely to be the case in any "real world" situation the managers are likely to encounter. The class discussion and feedback session should bring out these difficulties, and the instructor should emphasize that this problem is related to the current "state of the art," rather than to any shortcomings of the class.

As mentioned previously, the case studies are the final part of the curriculum module, and their completion marks the termination of the class. The instructor might want to end the sessions by asking if there are any remaining questions or points to be clarified, and by soliciting feedback concerning what class members felt they derived from the class.

APPENDIX A

PRODUCTIVITY MEASUREMENT BACKGROUND PAPER

The topic of productivity in the public sector has become of increasing interest to public administrators (and others) in recent years in response to increasing disparities between revenues and expenditures at the local level, and the well-publicized "fiscal crisis" in New York City and other major cities. The federal government has also shown considerable interest in the study of productivity, as has the academic community. Improved productivity appears to be one of the more feasible methods of reducing growth in local government expenditures without reducing provision of services (or, at least, without major service curtailment). Thus, understanding of the concept of public sector productivity, the difficulties of measuring it, and considerations involved in implementing productivity programs appears desirable for urban managers.

Defining Productivity

Productivity in the public sector may be generally described as "the efficiency with which resources are consumed in the effective delivery of public services."[1] This definition includes elements of quality as well as quantity. However, it is too general to be directly applied in a practical manner. In more usable terms, productivity measurement may be said to involve the relationship of outputs (preferably final outputs) and inputs, usually expressed as a ratio. Outputs represent that which is produced through the production process, while inputs consist of tangible and intagible resources. Ratios for two different time periods (or different locations at the same point in time) are utilized for comparative purposes. Contrary to popular opinion, increased productivity is not synonomous with more or harder work.

Measuring Productivity

One of the difficulties in implementing productivity programs lies in the area of measurement. Both input and output measures are required to determine productivity changes although the lack of depreciation information renders accurate measurement of total inputs into the production process difficult at best, the primary measurement problem involves outputs. Measuring public sector output (especially final output) is an exceedingly difficult task. One major reason for this difficulty is that government agencies are generally engaged in performing various types of service. The nature of most services - whether produced in the public or private sector - is that they are produced and consumed in a single operation, leaving no tangible unit of output to measure. The lack of physical outputs is less problematic in the case of private sector services because productivity can be estimated by use of prices associated with these services (e.g., in terms of dollars worth of output per man hour, for example). However, since public services are generally provided without direct charge, this method of productivity measurement is not applicable.

This shortcoming in public sector data has led to the evolution of a dual classification of public sector outputs. On one hand, output may be classified as that which is directly produced by the government agency - the service itself. This direct service tends to be measured in terms of activities, such as number of police patrols. On the other hand, the output may be classified as that which is of primary concern to the citizens or consequences (which may be considered "final" outputs). These are partly the result of direct outputs, but are also influenced by other factors in the local environment. An example of a consequence might be public safety, or freedom from crime, which could be (partially) measured in terms of crime rates.[2] Directly produced outputs are more easily quantified and are more closely controlled by the agency than the consequences of these outputs. Thus direct outputs are more useful as a measure of productivity. However, because of the importance of final outputs, effort should be made to incorporate some measures of these outputs in productivity improvement programs. Attempts should also be made to include indicators of quality of outputs.

In addition to these measurement problems, most public agencies have multiple objectives, and as a consequence, no single output measure will adequately represent service provision. Police departments provide a good example of multiple objectives, with goals of crime prevention, crime solution, arrest of criminals, recovery of stolen property, traffic control, and other public safety and assistance functions. Thus multiple indicators are often necessary for most public productivity studies.

Given the various problems regarding public productivity measurement outlined here, it appears useful to review some of the approaches taken (or suggested) with respect to productivity measurement.[3] At the simpliest level, either input or output measures alone may be used as proxies for productivity changes. Examples of these types of indicators for police services are: the number of police patrols as an input proxy for productivity, or the number of arrests as a direct output proxy. The ratio of output(s) to input(s) would be a more accurate measure of productivity, for example, arrests per man-year.

Consequences, or final outputs, may also be used as productivity proxies. In some instances, they may not be measurable because the service under analysis is preventive in nature. Thus crime prevention activities of the police cannot be quantified in terms of the number of crimes prevented. In these cases an inverse indicator must be used, i.e., the number of crime prevention failures, or crimes committed.

Improvements in management techniques and/or money-saving measures taken by government agencies have also been used as indicators of increased productivity, primarily in the context of the productivity program adopted in New York City. With the exception of output/input ratios, the above measures are not really satisfactory indicators of productivity. They have come into use in response to the need for proxy measures in cases where difficulties in measuring outputs and/or inputs have proved insurmountable.

An alternative approach to estimating productivity which does not require output measurement has been devised.[4] This approach utilizes changes in expenditure data as principal indicators. These changes are divided into three components: cost, workload, and a third (residual) factor reflecting changes in quality and productivity. The advantage of this approach is that expenditure data are readily available, and proxy measures for cost and workload may be calculated without significant difficulty. However, this technique also has the disadvantage of indicating changes in both quality and productivity in a single component. Therefore, further analysis is required to determine which of these two attributes is represented in the residual, and the direction and extent of the change in each attribute.

The above discussion outlines some of the major problems encountered in defining and measuring public sector productivity. No general solutions have emerged with respect to these problems. The various approaches identified have been applied, and will undoubtedly continue to be applied, by public sector agencies and/or researchers. The topic of public sector productivity is currently under considerable study and scrutiny; whether consensus on its definition and measurement will result remains to be seen.

Implementing Productivity Programs

While decisions regarding defining and measuring productivity are of great importance in undertaking a productivity program, there are other organizational and managerial aspects of such a program that also require consideration.

Perhaps the first such aspect involves a determination of the appropriate organizational level to which productivity programs should be directed. This problem may need to be considered on a city-wide as well as agency-wide basis. That is, it may be desirable to designate a city-wide position to supervise productivity improvement within all city agencies. At the same time, there will still be a need to determine the organizational level within each agency that should supervise the individual programs. Once the city-wide and agency-wide administration levels are selected, the indicators that might best be utilized in analyzing productivity in the separate agencies can be determined.

From a managerial perspective, one topic to be considered is the costs and benefits involved in undertaking a productivity program. While full-scale cost-benefit analysis might not be required in deciding whether or not to undertake such a program (which is a managerial choice in itself), some consideration should be given to major costs and benefits before commitment is made to undertaking a productivity program. Both monetary and non-monetary costs and benefits should be analyzed. Among the monetary costs major expenditures would include the cost of implementing the program, and the collecting of and analyzing of data. The primary monetary benefit would be anticipated cost savings as a result of productivity improvements. Non-monetary considerations include employee relations (to be discussed further below) and changes in power distribution (within agencies and/or at the city-wide level).

Constraints and potential implementation difficulties should also be considered before beginning a productivity program. These potential difficulties may fall within a cost-benefit analysis, or may be studied separately. The most obvious constraint is financial. There will be costs involved in analyzing productivity, such as personnel and computer costs involved in collecting and tabulating data. In addition, it may not be possible to undertake a productivity program in all agencies; therefore, decisions will have to be made as to where and when the program should be implemented on a limited basis. Additional cost constraints might be encountered after the results of productivity analysis have been obtained. These results might indicate the need for improved technology or new capital equipment to enhance productivity. If it is known beforehand that budget limitations will not allow for such costs, it might not be worthwhile to begin a productivity program. Since a considerable portion of the productivity gains experienced in the private sector have been associated with new equipment or technology, there appears to be some probability that significant gains in many public sector services might only be achieved with investment in these areas.

A final managerial aspect of productivity programs is consideration of the potential effects on employee relations. Implementation of such programs might meet with resistance on the part of employees--both unionized and non-unionized. Analysis of productivity could be perceived as a threat, and, therefore, employees might fail to cooperate with the program. Productivity might even decline as a result of introducing the program unless care is taken to make the objectives of the program known to employees and to make assurances regarding job security. If the results of the study indicate a need for changes in work rules or assignments, these changes could also meet with resistance. In cases where public employees are unionized, it is possible that the cost of productivity bargaining (i.e., wage increases in union contracts to work changes designed to increase productivity, or to agreed-upon indicators of productivity gains) in terms of wages might prove to exceed the benefits gained from changes introduced to increase productivity.[5] It may be possible to minimize employee resistance to a productivity program, however, by careful introduction of the program. Productivity improvement could be introduced as one of the goals of a Management By Objectives program, for example, which might be a satisfactory method of achieving productivity gains for at least some agencies.

Conclusion

The growing fiscal difficulties of many local governments indicates a need to find ways of reducing the growth in public expenditures, preferably without reducing public services. Productivity improvement in provision of public services appears to be one way of achieving this objective. However, there are difficulties involved in improving public sector productivity, not the least of which is defining and measuring productivity itself. Managerial difficulties and potential employee resistance might also make productivity improvement difficult to achieve. However, since there appear to be few "hard and fast" rules regarding public sector productivity, individual government units have freedom to experiment and determine a productivity improvement plan that best suits their needs. Only by experimentation with productivity programs at various government agencies will some of the difficult questions regarding practical productivity improvement be answered. The time has come to begin implementing productivity programs on a wide scale basis in order to alleviate the fiscal problems confronting government.

ENDNOTES

1. Nancy S. Hayward "The Productivity Challenge," Public Administration Review (September/October, 1976); 544.

2. For a more detailed discussion of these concepts, see: D. F. Bradford, R. E. Malt, and W. E. Oates, "The Rising Cost of Local Public Services; Some Evidence and Reflections," National Tax Journal 22 (June, 1969): 185-189.

3. For a detailed review of techniques used in measuring public sector productivity, see: John P. Ross and Jesse Burkhead, Productivity in the Local Government Sector (Lexington, Mass.: Lexington Books, 1974).

4. See Ross and Burkhead, Productivity in the Local Government Sector, pp. 95-108.

5. For a discussion of union resistance to productivity measures in New York City, see: Raymond D. Horton, "Productivity and Productivity Bargaining in Government: A Critical Analysis," Public Administration Review 35 (July/August, 1976) 407-414.

GLOSSARY

Consequences - Results of direct outputs. (See also final outputs.)

Direct output - The immediate outcome of the production process. When measuring services, this is generally an activity. (See also consequences.)

Effectiveness Measures - Effectiveness measures attempt to estimate the success of a particular program or output in reaching desired objectives such as changes in social states.

Efficiency measures - Efficiency measures are concerned with the manner in which resources are combined into final products. (i.e, production involving minimal waste, expense or unnecessary effort.)

Externalities - Spillover effects. Consequences of an action that affect parties not directly involved in that action (e.g., air pollution).

Final outputs - Consequences or effects of direct outputs of public sector production (see also direct output).

Input - A resource used in production, (land, labor, capital, raw materials, etc.).

Inverse Indicator - Measures the reverse of desired final output when the latter cannot be quantified. (e.g., when final output is preventive in nature.)

Labor intensive - Describes a production process which utilizes a greater proportion of labor than capital (equipment, etc.).

Management-by-objectives - A management method generally used with managerial level employees in which the supervisor and employees meet periodically to jointly establish objectives, evaluate the attainment of previous objectives, and determine methods to increase goal attainment.

Output - The goods and services generated through the production process.

Private sector - Broadly, the private sector coincides with the productive activities owned and operated by private enterprise.

Production - The conversion of physical inputs (land, labor, capital, etc.) into physical outputs (goods and services).

Productivity Bargaining - Formation of collective bargaining agreements which include changes in work rules, etc. Designed to achieve increased productivity and reciprocal worker gains.

Proxy - A substitute, particularly an indicator used to represent an output that cannot be readily quantified.

Public goods - Goods or services produced or provided by the government. In general, citizens have little control over the amount of consumption because these goods or services are not readily divisible. "Pure" public goods are defined as being equally available to all, once provided (e.g., national defense).

Public sector - The government sector of the economy; economic activities performed by various levels of government.

Instructor's Bibliography

Suggested Readings

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PRODUCTIVITY MEASUREMENT

Participant/Student Manual

Prepared by Dr. Elaine Morley

Module Number Eight
of
POLICY/PROGRAM ANALYSIS AND
EVALUATION TECHNIQUES Package VI

Developed by

CENTER FOR URBAN AND REGIONAL STUDIES
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Package VI

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TABLE OF CONTENTS

CHAPTER 1. INTRODUCTION---------- VI.8.1
Overview---------- VI.8.1
Instructional Strategies---------- VI.8.1
Objectives---------- VI.8.2
Resources and Time Requirements---------- VI.8.2

CHAPTER 2. THE MEANING AND MEASUREMENT OF PUBLIC SECTOR PRODUCTIVITY---------- VI.8.4
Objectives---------- VI.8.4
Defining Productivity---------- VI.8.4
Problems of Productivity Measurement in the Public Sector---------- VI.8.6
Methods for Measurement of Productivity in the Public Sector---------- VI.8.8
Worksheet 1---------- VI.8.16
Answers to Worksheet 1---------- VI.8.17

CHAPTER 3. ORGANIZATIONAL AND MANAGERIAL ASPECTS OF PRODUCTIVITY PROGRAMS---------- VI.8.19
Objectives---------- VI.8.19
Establishment of a Productivity Measurement Program---------- VI.8.19
Gaining Support for the Productivity Program---------- VI.8.20
Productivity Bargaining---------- VI.8.25
Costs and Benefits of Productivity Programs---------- VI.8.26

CHAPTER 4. PROCEDURAL ASPECTS OF PRODUCTIVITY PROGRAMS---------- VI.8.29
Objectives---------- VI.8.29
Selective Introduction---------- VI.8.29
Choice of Productivity Measures---------- VI.8.30
Quality of Public Services---------- VI.8.33
Goals of the Productivity Program---------- VI.8.35
Studying the Production Process---------- VI.8.35
Methods of Improving Productivity---------- VI.8.40

CHAPTER 5. CASE STUDIES---------- VI.8.45
Objectives---------- VI.8.45
Instructions for Case Studies---------- VI.8.45
An Overview of River City---------- VI.8.47
Police Department Annual Report---------- VI.8.48
Fire Department Annual Report---------- VI.8.50
Sanitation Department Annual Report---------- VI.8.51
Police Department Answer Sheet---------- VI.8.53
Fire Department Answer Sheet---------- VI.8.57
Sanitation Department Answer Sheet---------- VI.8.59

GLOSSARY---------- VI.8.62

BIBLIOGRAPHY---------- VI.8.64

CHAPTER 1. INTRODUCTION

Overview

The topic of productivity in the public sector has become of increasing interest to public administrators (and others) in recent years in response to changes in the government sector. One such change is the considerable increase in the size of the public sector, particularly at lower levels of government, which are of primary interest here. Between 1960 and 1973, state and local expenditures increased 272 percent, reaching over 184 billion dollars. This represented 14 percent of GNP in 1973. During the same period, employment by state and local governments increased 82 percent, reaching 14 percent of total U.S. employment. These figures may be compared to a 184 percent increase in federal expenditures, a 17 percent increase in federal employment, and a 42 percent increase in total U.S. employment.[1] Thus it is clear that state and local governments are playing an increasingly important role in the national economy. Therefore, further study of, and improvement in, productivity in this sector of the economy appears desirable.

An additional reason for interest in public sector productivity is the increasing disparities between available revenues and expenditure needs at the local level, and the well-publicized "fiscal crisis" in New York City and other major cities. Improvements in productivity appear to be one of the more feasible methods of reducing growth in local government expenditure without reducing provision of services (or, at least, without major service curtailment). Thus, some understanding of the concept of public sector productivity and the difficulties of measuring it, and considerations involved in implementing productivity programs is needed by urban managers. These are the topics to be covered in this learning module.

Instructional Strategies

While it is possible for the material presented herein to be used on a self-instructional basis, maximum benefits will be gained from its use in a group learning setting (which could be referred to by a variety of terms, such as seminar or training program, but the more conventional term, "class," will be used here). The instructional methodology will combine lectures, class participation, activities such as role playing, and case studies to be worked through by participants. Class participation, in terms of general discussion as well as the case studies, is an important part of the learning experience. Since many class members will hold management positions in various local agencies and departments, their accumulated knowledge and insights will serve to enhance the material presented as they enrich the discussion with examples, problems and suggestions drawn from personal experience. Thus, the class members are a valuable resource and their active participation is a key factor in the success of the learning experience.

Objectives

The goals of this module are to familiarize the participant with the meaning of productivity in the public sector, the problems encountered in its measurement, and considerations involved in implementing productivity programs. The latter topic includes organizational and managerial aspects of productivity programs. The module does not attempt to prescribe methods for improving productivity, as these are best determined for each individual case by those familiar with prevailing circumstances. However, consideration will be given to productivity improvement methods that have been attempted or suggested. Exposure to the main concepts involved in productivity measurement and the potential problems of implementing such programs will provide a basis on which the individual manager can build a productivity program best suited to the particular agency.

Resources and Time Requirements

No specialized resources are required for this learning module. A "pocket" calculator would prove useful for portions of the course. However, it would not be necessary for all class members to have a calculator; a few would be sufficient for the whole class on a shared basis.

The time frame for this module as a classroom experience is estimated at two working days (approximately 12-14 hours). This considers time for class discussion and working on case studies. Clearly, there is room for variation in this estimate depending on characteristics and needs of individual groups. However, it appears unlikely that a longer time period would be required, while it may be possible that a class could finish the module in a shorter time. Time estimates for module subdivisions will be given at the beginning of each chapter. No time is required for out-of-class exercises; however, a bibliography is supplied from which the participant might select materials to further increase his or her understanding of topics presented in class. A glossary is also included at the end of the student manual.

ENDNOTES

1. Economic Report of the President, 1975, cited by David Greytak, Donald Phares and Elaine Morley, Municipal Output and Performance in New York City (Lexington, Mass.: Lexington Books, 1976), p. 7.

CHAPTER 2. THE MEANING AND MEASUREMENT OF PUBLIC SECTOR PRODUCTIVITY

Objectives

The major objectives of this chapter are to introduce the topic of productivity in the public sector and to familiarize the student with particular problems encountered in its measurement. This will be done in a series of steps. First, productivity will be defined in general terms and techniques used for its measurement in the private sector will be outlined. The measurement difficulties encountered in the public sector will then be introduced. A discussion of techniques which have been applied to, or suggested for, public productivity measurement concludes this chapter. Admittedly, these objectives are not precise nor quantifiable. This is unavoidable due to the nature of the subject matter. There is no consensus on how productivity should be measured in the public sector, nor are there proven methods of productivity improvement that may be applied to all situations. This chapter attempts to summarize various perspectives about public sector productivity, in the belief that understanding of them will enable better decision-making on the part of local officials. No prescriptions are offered here, because variations in individual conditions will affect the choice of methodology. The local decision maker will need to analyze the circumstances and select the "best" approach to productivity measurement and/or improvement given the constraints. It is hoped that the information presented here will provide the necessary background for better decision-making. Time estimated for material in this section is 3-4 hours (for a classroom situation, not self-instructional).

Defining Productivity

Before clarifying the concept of productivity in the public sector, a more general discussion of the meaning and measurement of productivity will be presented. Due to the complexity of the topic and the lack of agreement concerning methods of productivity measurement and the interpretation of different types of measures, this overview should not be regarded as comprehensive.[1]

Productivity measurement deals with the production process, which may be viewed as the conversion of various input factors (e.g., capital, labor) into direct outputs (goods or services).[2] Two general kinds of measurement are normally applied to the production process: efficiency and effectiveness measures. Efficiency measures are concerned with the manner in which resources are combined into final products. Three types of efficiency measures are:

1) work measures - which are usually expressed as tasks per unit of time.

2) cost measures - which are expressed as the ratio of current dollars of input per physical unit or constant dollar of output.

3) productivity measures - which are expressed as the ratio of physical units of output to physical units of input.

It should be noted that there is not necessarily a simple, direct relationship between these three measures of efficiency.

Effectiveness measures concentrate on the consequences of the production process rather than the process itself. They may be expressed in terms of: inputs to consequences; outputs to consequences; and/or consequences to goals. Effectiveness measures are generally associated with public sector production since, in their broadest sense, they attempt to estimate changes in social states, which is not a typical concern of the private sector. The use of effectiveness measures has been impeded by the lack of a theory which relates inputs and/or outputs to consequences or consequences to goals. In other words, a concept similar to the production process cannot be simply or formally expressed with respect to consequences. The concept of consequences will be considered again when problems of public sector productivity measurement are discussed. Before this, some aspects of private sector productivity measurement will be explored to provide background information helpful to understanding productivity measurement in the public sector.

As stated above, productivity is measured by the ratio of output(s) to input(s). The ratio is usually compared with corresponding ratios for a different period of time or location. Outputs of the production process in the private sector are usually expressed in dollar terms (price per unit multiplied by the number of units produced). The use of prices enables heterogeneous physical outputs to be aggregated and/or compared. The measurement of inputs is somewhat more complex. Most outputs are produced with some combination of labor and capital (e.g., machinery, equipment).[3] Productivity may be measured in terms of one input, usually labor, or in terms of a combination of inputs, usually labor and capital. These measures are referred to as labor productivity and total factor productivity, respectively. Within these categories there are several ways of quantifying inputs and interpreting the resulting productivity indicators. In the following discussion, greater emphasis will be placed on labor productivity because this measure will be stressed later in discussing productivity analysis in the public sector.

Two of the ways in which labor inputs may be quantified are the number of persons employed and/or the number of labor-hours expended. Both of these measures assume that labor is homogeneous; i.e., all persons employed or all hours of labor are identical in terms of quality. The concept of labor quality may be explained in terms of worker attributes which affect the production process. These include such attributes as education, skill, experience and physical characteristics.

This complex of characteristics may be referred to as "human capital." An alternative approach to measuring labor inputs recognizes the heterogeneous nature of labor and attempts to account for it by use of weighted labor measures. The weights would be some indicator of earnings, such as average hourly earnings. This approach assumes that earnings reflect differences in labor quality. While this is undoubtedly true, earnings also reflect other factors, such as differences in the degree of unionization and geographic variation in wages. Therefore, the extent to which weighted labor measures reflect differences in labor quality is uncertain, which renders this approach somewhat less useful.

The labor unit selected for use has important effects on interpretation of the productivity index. If total employment is used, an increase in hours worked would be interpreted as a productivity gain, while if labor-hours were used, this change would be correctly interpreted as an input increase. However, higher quality labor, also an input increase, would be reflected as a productivity gain in both these cases, while it would be correctly shown by use of weighted labor hours as the input measure.

While single factor productivity indexes may be preferable to total factor indexes because their construction requires less data, the interpretation of the former presents some difficulties. Increases in output per labor-hour (the most frequently used indicator) should not be regarded as resulting only from increased labor efficiency. Such increases reflect changes in several factors. Thus a gain in output per labor-hour could be caused by: substituting capital for labor; technological change; management and organizational change; changes in quality of labor; or some combination of these (and possibly other) factors. Thus care must be taken in interpreting productivity measured by one factor, and the factor utilized must not be attributed with the total measured change in productivity.

Total factor productivity is a more complex index which uses a weighted sum of labor and capital inputs, with each factor weighted according to its relative share of total inputs. Application of this approach implies assumption of an aggregate production function specifying the relationship between total inputs and outputs. Total factor productivity has primarily been used to study aggregate economic growth, which is beyond the scope of this course. Therefore, further examination of this approach will not be undertaken here.

The above outlines the concept of productivity and methods used for its measurement in the private sector, as well as some of the problems incurred in measurement and interpretation.[4] However, productivity measurement in the public sector presents different concepts and problems, which will be explored in greater detail below.

Problems of Productivity Measurement in the Public Sector

The public sector has presented serious difficulties in the area of productivity measurement for a number of reasons. The major problem is that production in the public sector is almost completely devoted to services. Measurement of productivity with respect to services has proved extremely difficult, in the private or public sector, as will be explained below. Moreover, particular characteristics of the public sector add to the problems of productivity measurement related to its service orientation.

The service nature of the public sector renders output measurement extremely difficult.[5] Services, whether privately or publicly supplied, may be defined as being produced and consumed in a single operation; that is, they "perish" in the act of performance. Thus, there are no tangible units of output to be quantified to supply the numerator of a productivity ratio. In addition to this problem, public services, unlike private ones, are generally provided without direct charge. In the case of many public services, the quantities provided cannot be divided among citizens, who have little choice regarding the quantity of service consumed. These are some of the characteristics of "public goods" which, in the pure case, are equally available to all once they are provided (e.g., national defense). Thus, the value of services supplied to the consumer cannot be estimated by multiplying price by quantity, as is possible in the private sector, since these dimensions are not available.

These shortcomings in public sector data have led to the evolution of a dual classification of public sector outputs. On one hand, output may be classified as that which is directly produced by the government agency--the service itself. These direct outputs tend to be measured in terms of activities, such as the number of police patrols. On the other hand, the output may be classified as that which is of primary concern to the citizens, or consequences. These are partly the result of direct outputs, but are also influenced by other factors in the local environment. An example of a consequence might be public safety, or freedom from crime, which could be (partially) measured in terms of crime rates.[6] Directly produced outputs are more easily quantified and are more closely controlled by the agency than the consequences of these outputs. Thus direct outputs would appear to be more useful as a measure of productivity. It should be pointed out that the most appropriate direct outputs or activities to use are those of a "final" nature as opposed to intermediate activities. Thus the number of arrests would be a more suitable direct output measure than the number of suspects interrogated, which is an intermediate activity in the process of making arrests. However, it may also be argued that the consequences expected from direct outputs provide the reason for public service provision in the first place, and that these consequences should therefore be included in some way in assessing the productivity of public services. However, this is not always possible.

As noted previously, the concepts of efficiency and effectiveness may be used in conjunction with the above output classifications. Efficiency measurement deals with the way in which resources are converted into outputs without evaluating the effect or appropriateness of the outputs. The concept of efficiency would be applicable to activity measures. Effectiveness measures, however, deal with the consequences of the output, and do seek to evaluate the appropriateness of the output.

In addition to these measurement problems, the number and types of outputs produced must be considered. Most public agencies have multiple objectives, and as a result no single output measure will adequately represent service provision for the agency as a whole. Police departments provide a good example of multiple objectives, with goals of crime prevention, crime solution, arrest of criminals, recovery of stolen property, traffic patrol and general public safety and assistance functions. In addition to the problem of multiple objectives, even outputs directed toward one goal may be sufficiently disparate in what might be termed "quality" to make aggregation impossible. Public education may serve as an example of this problem. It might be agreed that hours of classroom instruction may be used as a direct output measure. However, it is intuitively clear that there are considerable differences in the "quality" of classroom instruction between elementary and higher education, for example. Thus, one could not aggregate hours of instruction at kindergarten and college levels. Therefore, multiple indicators would be required in agencies with heterogeneous outputs to account for the quality variation in these outputs.

The above may be considered the major problems in measuring productivity in the public sector. Two other problems should be noted briefly here. One is that many local governments do not collect the types of data most appropriate for analysis of output/input relationships. This may necessitate additional data gathering or use of less-than-optimal indicators of productivity change. (The subject of data availability will be discussed further in Chapter 3.) The second problem is selecting the appropriate level at which to analyze productivity. While it may be argued that the governmental unit is the appropriate level, other possibilities include the service level (e.g., police service, sanitation service) or even sub-functions of service departments (e.g., detective function of police service). The approach taken here is that the service level provides the most meaningful and useful measurement for the general public sector administrator. Sub-functional measurement may be appropriate in addition to service level measurement under some conditions. However, the focus here will be on the former.

The foregoing outlines problems associated with measuring productivity in the public sector. A review of approaches taken to, or suggested for, public productivity measurement follows.

Methods for Measurement of Productivity in the Public Sector

Given the above-outlined difficulties of measuring productivity in the public sector, it appears useful to consider some of the approaches taken (or suggested) with respect to this task. It should be noted that there is not as yet one agreed upon method for measuring local government productivity. A review of the basic methods employed and the advantages and disadvantages of each should prove helpful in both further clarifying the productivity measurement problem and in helping the decision-maker select measurement methods best suited for prevailing circumstances.

At the simplest level, either input or output measures (direct or final outputs) may be used alone as proxies for productivity. Each of these proxies will be considered in turn.

Examples of input proxies include labor, materials, expenditure, and work units, such as police patrols or classroom hours of instruction. The underlying assumption in using inputs as productivity proxies is that these inputs are directly related to desired final outputs, and the input increase will be translated into an equivalent output increase. However, this assumes that no value is added by the public sector. The approach does not describe productivity in the sense of an output/input ratio. If outputs increase proportionately more than inputs as a result of the increased inputs, then productivity will have increased. However, since this method uses input measures only, it is impossible to determine whether productivity has actually increased.

The advantage of this method is that it is simple to use and employs data that are readily available (i.e., some kind of input statistics should be readily obtainable for any agency or department), both for current and past reporting periods. Thus, expenditures and efforts involved in data gathering would be relatively low. The major disadvantage of this method, of course, is that it doesn't really measure productivity.

Measuring direct outputs alone as a productivity proxy is somewhat similar to the above approach. Direct outputs could be any activity performed in the public sector, such as the number of fires extinguished or arrests made. The approach assumes that gains in output may be equated with productivity gains. Of course, this is only true if outputs have increased more than inputs, which cannot be determined by the study of outputs alone. Therefore, this approach has the same shortcoming as use of inputs as proxies, namely that it is not a productivity measure. It has the same advantages; simplicity and use of generally available data (most agencies that provide services to the public keep some kind of record of services rendered, at least in terms of major activities).

Consequences may also be used as productivity indicators, with similar comments applicable to their use. However, consequences are an effectiveness measure, not an efficiency measure, which indicates they are not really suitable as proxies for productivity. They may be useful because they reflect service provision in terms of units in which the citizen has considerable primary interest, such as crime rates. Some researchers argue that productivity should be broadly defined to include concepts of effectiveness and efficiency, and that changes in consequences should be measured in such a way that both of these characteristics are included. This approach would necessitate multiple indicators of productivity. Some aspects of this approach will be discussed under the heading of quality of public services in Chapter 4, but the broadened definition of productivity will not be used herein. It should be pointed out that some consequences present an additional measurement problem when the service under analysis is preventive in nature. Thus, crime prevention activities of the police cannot be quantified in final output form as the number of crimes prevented, as these cannot be ascertained. In such cases an inverse indicator must be used, i.e., the number of crimes committed, which indicates failure to prevent crimes. A reduction in the inverse indicator represents an increase in prevention.

The use of output/input ratios is regarded as the only method which measures productivity as generally defined. The problems with this method lie mainly in determining what output and input measures to use. If direct output measures are used, it may be argued that these are not of primary importance, and that consequences should be utilized (although these may not be as readily available as direct outputs). However, it may be argued that variations in consequences are influenced by environmental factors as well as the inputs to which they are related in analyzing productivity. Thus, it appears unfair to measure productivity of an agency which cannot completely control the output by which it is judged. The appropriate input measure must also be selected. Since services are labor-intensive, a labor measure appears to be a good input indicator. The problems associated with use of labor as an input measure have been discussed previously, and are applicable to the public sector as well as the private sector. Expenditure has been used as an input, thus measuring productivity in terms of outputs received per dollar spent. It is difficult to attempt to use capital (or labor and capital) as an input because the distribution of capital equipment among employees varies considerably within and between public sector agencies, making measurement and comparisons difficult. Thus, the major disadvantages of this method appear to be problems of selecting the most appropriate indicators. The advantage is that this method does measure productivity, even if it may be used for only some quantifiable functions of an agency.

Improvement in management techniques and/or money-saving measures used by government agencies have also been used as productivity indicators, primarily as one type of indicator in the productivity program adopted in New York City. The rationale for this approach appears to be that a money-saving measure effectively allows production of a given level of outputs with a reduced money input, which is technically a productivity improvement. Thus, if the city is able to buy supplies at a lower cost by changing vendors, money is saved and productivity is said to have increased. However, it is not appropriate to consider cost reduction or service reorganization alone as indicators of improved productivity. The output results of such changes must be compared to inputs to determine whether there has been a productivity improvement. Thus, this method does not appear to be a productivity measure in the usual sense of the word. The advantage of the approach is that it emphasizes and encourages improved management and/or money-saving techniques, which are beneficial to the fiscal position of the city.

An alternative approach to estimating productivity somewhat similar to the total factor productivity approach has recently been devised.[7] This approach, which will be referred to as the "fiscal approach," utilizes changes in expenditure data in estimating productivity change, and is used to calculate productivity change for individual departments or agencies. Expenditure changes are divided into three components:

cost, workload, and a third factor representing changes in quality and productivity. An explanation of the stages in development of this model are presented below; a discussion of its use, advantages and disadvantages will follow. The stages of model development are shown here for the purpose of enhancing understanding of underlying concepts involved in its formulation. However, it is not necessary that the mathematical development be understood in order to utilize the model in its final form. The final stage of the model involves a simple mathematical expression into which values for the service under study are inserted. Therefore, the model can be applied by those who do not have a mathematical background sufficient to fully grasp its development. An exercise is presented at the end of this chapter which provides an opportunity to work with the final stage of the model and interpret the results obtained.

The model assumes a multiplicative linear relationship among the variables noted above, and examines the change in these variables over time, utilizing data for beginning and terminal time periods (denoted by subscripts 1 and 2, respectively). In general terms, assume a relationship can be shown as:

$$\frac{N_2}{N_1} = \left(\frac{X_2}{X_1}\right)\left(\frac{Y_2}{Y_1}\right)\left(\frac{Z_2}{Z_1}\right)$$

and that data are available only for $\frac{N_2}{N_1}$, $\frac{X_2}{X_1}$, and $\frac{Y_2}{Y_1}$. If $\left(\frac{X_2}{X_1}\right)\left(\frac{Y_2}{Y_1}\right)$ does not equal $\frac{N_2}{N_1}$, then $\frac{Z_2}{Z_1}$ may be regarded as an explanatory (or residual) term, incorporating both the influence of factors other than changes in X and Y on changes in N and an error component.

The approach used to analyze expenditure changes in the public sector follows the concepts shown in the hypothetical relationship expressed above. Initial and terminal years will be shown by subscripts 1 and 2. Expenditures, E, will be expressed as a function of costs, C, workload, W, and a residual term, R. C may be considered as representing costs of inputs, while W represents a quality measure. Thus, expenditure can be seen as being expressed in general terms of "price times quantity." Costs and workloads will be stated in terms of an index (e.g., 1.5). The cost index should be derived, as far as possible, from the cost of a basic, relatively homogeneous input that is believed to have a high positive linear correlation with overall cost trends. For example, the entering salary of personnel representing the major portion of the workforce of an agency, such as police officers, fire-fighters, social service caseworkers, etc. Workload should be defined in terms of population served, such as the number of students enrolled in public schools, or the number of persons receiving welfare.

The basic equation of the model (shown below) will be rearranged and partitioned in a series of steps to allow weights to be assigned to the components of expenditure change, which will be explained in greater detail below. The basic equation is expressed as:

$$\frac{E_2}{E_1} = \left(\frac{C_2}{C_1}\right)\left(\frac{W_2}{W_1}\right)\left(\frac{R_2}{R_1}\right).$$

This can be rewritten as:

$$\frac{R_2}{R_1} = \frac{E_2}{E_1\left(\frac{C_2}{C_1}\right)\left(\frac{W_2}{W_1}\right)}$$

The term $E_1\left(\frac{C_2}{C_1}\right)\left(\frac{W_2}{W_1}\right)$ represents estimated expenditure in the terminal year based on actual expenditure in the initial year and changes in cost and workload. This projected value for expenditure is defined:

Definition 1: $P(E_2) = E_1\left(\frac{C_2}{C_1}\right)\left(\frac{W_2}{W_1}\right).$

This estimate may be subtracted from actual expenditure in the terminal year, leaving a remainder denoted by R*.

Definition 2: $R^* = E_2 - P(E_2).$

R* represents the portion of actual expenditure in the terminal period that is caused by factors other than changes in cost and workload. These include changes in productivity and quality, as well as an error term. Interpretation of the residual term will be discussed further below.

The basic equation is next rearranged in order to allow weights to be assigned to each component of expenditure change. (Actual change may be shown as $\Delta E = E_2 - E_1$.)

Definition 3: $\Delta c = \frac{C_2}{C_1} - 1$ and $\Delta w = \frac{W_2}{W_1} - 1.$

Therefore, $\frac{C_2}{C_1} = 1 + \Delta c$ and $\frac{W_2}{W_1} = 1 + \Delta w$. Δc and Δw are the percent change of the respective components expressed in decimal form.

A partitioning equation is developed in the following sequence. A cross product term ($\Delta c \Delta w$) is developed in equation 3. The cross product term recognizes that cost and workload are not necessarily independent variables in the local government setting. Indeed, government units may attempt to manipulate one of them in response to changes in the other. For example, a government unit might attempt to "compensate" for an increase in salary by increasing the workload of those receiving the raise.

1) $E_2 = R^* + P(E_2)$ (from Definition 2)

2) $\Delta E = E_2 - E_1 = R^* + P(E_2) - E_1$

3) $P(E_2) = E_1(1 + \Delta c)(1 + \Delta w) = E_1 + E_1 (\Delta c + \Delta w + \Delta c \Delta w)$
(from Definitions 1 and 3)

4) $\Delta E = R^* + E_1 (\Delta c + \Delta w + \Delta c \Delta w)$
$= R^* + E_1 \Delta c + E_1 \Delta w + E_1 (\Delta c \Delta w)$

The cross product term in equation 4 is partitioned by use of an identity equation (equation 5), which is then inserted into equation 4 and rearranged to become equation 6. Absolute values of the quantities Δc and Δw are used in the partitioned equation to obtain proportional weighting of the effect of the changes in cost and workload. Absolute values refer to the numerical value of a term without regarding its sign. For example, the absolute value (represented by straight vertical lines surrounding the term) of both +5 and -5 is 5.

5) $E_1 (\Delta c \Delta w) = E_1 (\Delta c \Delta w) \left[\frac{|\Delta c|}{|\Delta c| + |\Delta w|} + \frac{|\Delta w|}{|\Delta c| + |\Delta w|}\right]$

6) $\Delta E = R^* + E_1 \left[\Delta c + \Delta c \Delta w \left(\frac{|\Delta c|}{|\Delta c| + |\Delta w|}\right)\right]$
$+ E_1 \left[\Delta w + \Delta c \Delta w \left(\frac{|\Delta w|}{|\Delta c| + |\Delta w|}\right)\right]$

The terms enclosed in brackets in equation 6 will be used to show the proportion of change that may be attributed to changes in C and W alone. This equation recognizes interaction between C and W in the cross product term, and by use of the partitioned terms $\frac{|\Delta c|}{|\Delta c| + |\Delta w|}$ and $\frac{|\Delta w|}{|\Delta c| + |\Delta w|}$ separates the share of change due to interaction that may be attributed to C and W, respectively. Thus, the term $\Delta c \Delta w \left(\frac{|\Delta c|}{|\Delta c| + |\Delta w|}\right)$ may be interpreted as the portion of change in the cross product term that may be attributed to influences of cost alone.

The percentage distribution of the effects of the three components on expenditure change is obtained by dividing the partitioning equation by the value of change in expenditure (ΔE) and multiplying by 100. A numerical example is given here to clarify the process:

$E_1 = 1000; E_2 = 1400; \Delta E = 400$

$\frac{C_2}{C_1} = 1.5; \frac{W_2}{W_1} = 0.9$

$P(E_2) = (1000)(1.5)(0.9) = 1350$

$R^* = 1400 - 1350 = 50$

$\Delta c = (1.5 - 1) = 0.5; \Delta w = (0.9 - 1) = -0.1$

The partitioning equations are:

$$\frac{|0.5|}{|0.5| + |-0.1|} = \frac{0.5}{0.6} = \frac{5}{6} \text{ and } \frac{|-0.1|}{|0.5| + |-0.1|} = \frac{0.1}{0.6} = \frac{1}{6}.$$

Inserting these numerical values into equation 6 yields:

$$\begin{aligned}400 &= 50 + 1000\,[(0.5) + (0.5)(-0.1)(5/6)] \\ &\quad + 1000\,[(-0.1) + (0.5)(-0.1)(1/6)] \\ 400 &= 50 + 458.3 - 108.3.\end{aligned}$$

Dividing both sides of the equation by 400:

$$1 = 0.125 + 1.145 - 0.27.$$

Multiplying by 100:

$$100 = 12.5 + 114.5 - 27.0.$$

Thus, 100 percent of expenditure change may be attributed in the following manner: 114.5 percent to cost; -27 percent to workload, and 12.5 percent to the residual component.

Interpretation of the residual term remains to be discussed. As previously noted, this term is felt to reflect changes in productivity and quality as well as including an error term (which cannot be estimated and will be disregarded in the remainder of this discussion). A positive residual component indicates that actual expenditures in the terminal time period were higher than projected expenditures--meaning that cost and workload increases did not fully account for expenditure growth. There are several possible explanations for the additional expenditure. One may be interpreted as a general quality increase--that additional expenses were for higher quality inputs, or provision of better services or perhaps a wider range of services. The second major factor in the residual component is productivity. This may be considered in terms of output per labor-year, or in cost terms as a reduction in cost per unit of workload. In the case of the positive residual term, the expenditure increase above that accounted for by cost and workload changes may indicate a decline in productivity. It is also possible that the positive value of R* may represent some combination of change in both quality and productivity. A negative value of R* may be interpreted in a similar fashion, but representing either a decline in quality, or an increase in productivity, or some mixture of the two, not necessarily in opposite directions.

It should also be noted that productivity increases might be reflected in the cost index if public sector wages are related to labor productivity. But if labor productivity increases, this means fewer employees are needed to handle the same workload, so a reduction in expenditure could occur. Thus, it would be necessary to examine changes in cost, workload and the number of employees to ascertain whether productivity has increased.

The above indicates that interpretation of residual values is not a simple task. Since the intent of this model is to determine productivity change, it seems desirable to try to separate effects of quality and productivity changes in the residual. Unfortunately, a satisfactory method for doing this has not been devised. One might assume that quality remained constant and attribute all of R* to productivity change, but this does not increase understanding of the service under analysis. Alternatively, one might attempt to identify one or more quality indicators for each service. The direction and magnitude of change in these indicators could then be used to give insight into the probable direction and magnitude of the productivity portion of the residual. Thus, in the case of a positive R*, if one can determine that a major quality change did occur, then it would appear reasonable to assume that productivity did not decline. While no exact measures of productivity will result from this approach, it will serve to provide some clarification of the meaning of the residual term.

The difficulty in interpreting the residual term, and, therefore, in determining productivity change, presents a major drawback of this approach. This approach also does not present productivity change in terms of an output/input ratio. However, it does have the advantage of being a comprehensive approach, in that it attempts to identify productivity change for a whole department or agency. It also has the advantage of using data that are generally readily available (expenditure, cost and workload), and does not require attempts to identify and quantify outputs. This approach may be most useful if applied on a limited basis to determine which agencies may have had productivity decreases and are therefore in need of further examination.

This chapter has focused on exploring the meaning of productivity in the public sector and examining the problems encountered in its measurement. Methods applied to public productivity measurement have been reviewed. Aspects of productivity improvement that have organizational and managerial implications will be considered in the next chapter.

Worksheet 1

Using the equations shown below, calculate the proportion of expenditure change attributable to cost, workload, and quality/productivity for the following two cases:

$$P(E_2) = E_1 \left(\frac{C_2}{C_1}\right) \left(\frac{W_2}{W_1}\right) \qquad R^* = E_2 - P(E_2)$$

$$\Delta c = \frac{C_2}{C_1} - 1 \qquad \Delta w = \frac{W_2}{W_1} - 1$$

$$E = R^* + E_1 \left[\Delta c + \Delta c \Delta w \left(\frac{|\Delta c|}{|\Delta c| + |\Delta w|}\right)\right] + E_1 \left[\Delta w + \Delta c \Delta w \left(\frac{|\Delta w|}{|\Delta c| + |\Delta w|}\right)\right]$$

Note: In performing calculations, decimals should be rounded at the fourth or fifth place (i.e., .ooox), where applicable.

Case 1:

Total expenditure in the initial time period was $1,000; in the terminal time period it was $1,800. The cost index ($C_2/C_1$) is 1.6, the workload index (W_2/W_1) is 1.1.

Case 2:

Total expenditure in the initial time period was $1,000; in the terminal time period it was $1,500. The cost index is 1.3; the workload index is 1.2.

Answers to Worksheet 1

Case 1:

$P(E_2) = 1760$; $R^* = 40$

$\Delta c = 0.6$ $\Delta w = 0.1$

Percent of change attributable to each component:

R*	C	W
5.0	81.4	13.6

Case 2:

$P(E_2) = 1.560$ $R^* = -60$

$\Delta c = 0.3$ $\Delta w = 0.2$

Percent of change attributable to each component:

R*	C	W
-12.0	67.2	44.8

The residual term accounts for about 5 percent of total change in the first case. If all of the residual is attributed to productivity, this would indicate a reduction in productivity has taken place. However, it is also possible that an improvement in quality has occurred, or some combination of the two possibilities. Without further information, nothing more certain can be determined. The second case shows a negative residual term, which indicates the possibility that productivity improved in this instance. However, a quality decrease or combination of factors could also be the explanation in this case.

ENDNOTES

1. For a more thorough review of productivity, see: Solomon Fabricant, A Primer on Productivity (New York: Random House, 1969), and John P. Ross and Jesse Burkhead, Productivity in the Local Government Sector (Lexington, Mass.: Lexington Books, 1974): 11-32. The material presented here draws heavily on the latter.

2. A formal statement of the relationship between inputs and outputs is called a production function.

3. Other inputs are also involved in the production process, such as energy and raw materials. However, since labor and capital are most commonly utilized in productivity measurement, other inputs will be disregarded here for the sake of simplicity.

4. The discussion of labor productivity is abstracted from that presented in Ross and Burkhead, Productivity in the Local Government Sector: 17-25.

5. Input measurement, particularly in terms of labor, does not present a significant problem. However, total factor input would be extremely difficult to estimate due to lack of depreciation information.

6. For a more detailed discussion of these concepts, see: D. F. Bradford, R. E. Malt, and W. E. Oates, "The Rising Cost of Local Public Services; Some Evidence and Reflections," National Tax Journal 22 (June, 1969): 185-189.

7. The methodology presented here and its explanation is drawn from that given in Ross and Burkhead, Productivity in the Local Government Sector, pp. 101-108.

CHAPTER 3. ORGANIZATIONAL AND MANAGERIAL ASPECTS OF PRODUCTIVITY PROGRAMS

Objectives

The major objectives of this chapter are to introduce some of the managerial and organizational considerations related to implementing productivity programs. Selection of the appropriate organizational levels from which productivity programs should be directed will be discussed first. Gaining support for a productivity program, with emphasis on labor-management relations and potential problems in this area will then be outlined. The topic of productivity bargaining will be discussed briefly, followed by an overview of cost-benefit considerations. Some of the topics included in this chapter have received little attention in the literature on productivity analysis, and their inclusion here is directed toward stimulating thought and discussion rather than toward presenting established procedures. Thus class participation is of particular importance in this portion of the learning module. Estimated time for Chapter 2 in a class setting is 2-3 hours.

Establishment of a Productivity Measurement Program

Among the first things to be considered in initiating a productivity measurement program are matters of managerial concern. These aspects appear to have been generally overlooked in the literature on productivity, possibly because such matters tend to be strongly influenced by factors affecting the individual government unit. Therefore, the discussion here will concentrate on indicating some of the main points to be considered in a general sense.

The first factor to consider is the organization of the productivity measurement unit. There are two general forms that could be utilized. A centralized unit in charge of productivity measurement for the entire government unit could be formed. An alternative would be a decentralized approach, with each service agency responsible for its own productivity measurement and improvement. In practice, it is quite likely that a combination of the two would occur - with a centralized unit having responsibility for the program on an areawide basis, and with productivity units in each agency responsible for that agency. Responsibilities that appear appropriate for the respective levels are outlined below.

The city-wide[1] productivity program office will have two major functions. First, it must introduce the program in each city agency and gain support for it as a new program. Second, it must coordinate the on-going productivity program, analyze the results on a city-wide level, and look for problem areas (and assist in solving them). Thus this office will have a considerable amount of responsibility and power. It could be located within existing city departments (such as budget or personnel), or could be set up as a separate department. The latter would tend to give it greater visibility, particularly in terms of media coverage, which might be particularly desirable during introduction of the program when support must be generated from both government employees and the general public. Availability of funds may have some influence over whether or not the program should be organized as a separate department. (Budget considerations will be discussed later in this chapter under cost-benefit considerations of productivity programs.)

The individual agencies involved in the productivity program will need an agency-level productivity office performing the same basic functions as the city-wide office (introduction, coordination, analysis, problem solving). It would supervise the productivity efforts of various departments within the agency and/or agency-wide productivity efforts. It, too, could be located within an existing agency department or be organized as a new department.

Staffing is another topic that must be considered in initiating a productivity measurement unit, whether on a centralized or decentralized level. There are two basic choices in staffing - to draw staff from existing departments or to bring in new personnel. The former approach has the advantage of using people familiar with the institution and its procedures but has the disadvantage of reducing the possibilities for new and creative approaches. In other words, outside staff are less likely to have rigid ideas about how a service "should" be delivered than long-time employees of an agency, and might, therefore, offer more innovative suggestions. Thus it would appear beneficial to have at least some of the staff drawn from outside the institution. A second consideration in selecting staff, of course, is the need for people with sufficient quantitative abilities to perform the data gathering and analysis tasks necessary in productivity measurement.

The above outlines factors involved in organizational location and staffing of productivity programs. It should be emphasized that this matter requires careful consideration because of the potential power and responsibility encompassed in these offices. They could have considerable impact on the existing distribution of power within the respective organizational frameworks; awareness of this and proper initial location could avert problems resulting from resistance on the part of departments or individuals feeling they are losing power or influence as a result of the location of the productivity office.

Gaining Support for the Productivity Program

A major managerial concern is gaining support for the productivity program as it is introduced and throughout its operation. Support is necessary from a variety of groups, perhaps the most crucial of which is labor. A variety of topics related to support will be discussed below, with particular emphasis on labor-management relations.

One aspect of gaining support involves promoting the program to various groups whose support is needed. These groups may vary according to individual government units, but typically could include agency heads and their staffs, elected officials, members of the legislative body, the general public and specific citizen organizations, and the media. A critical factor in promoting the program is to state its goals in realistic terms. Efforts should be made to avoid having the program "sold" - or erroniously interpreted - as a panacea for government problems. A productivity program will simply be one step toward improving the efficiency of local government - not a mean accomplishment in itself! Thus care should be taken to explain exactly what can be expected of the program to avoid unrealistic expectations which might lead to its ultimate downfall when they are not met.

Perhaps the most important group from which support and acceptance is needed is public employees. Therefore, care must be taken to introduce the program in a way that encourages support as well as understanding. In this case also there are no established rules as to appropriate procedures, and the individual characteristics of each city as well as the various agencies within it and the historic pattern of labor-management relations should be considered in formulating an approach to introduce the productivity program. Some of the major points to consider with respect to employee relations will be outlined here, but it is not implied that this group is all-inclusive.

Perhaps the major potential problem area in any productivity program is the possibility of employee resistance. Such resistance is likely to be largely related to fear--particularly fear of losing one's job. Thus care must be taken from the beginning to assure employees that the productivity program is not being introduced as a means of finding reasons to fire employees. While eventual productivity gains might allow for personnel reductions, this can be accomplished through reduced future hiring and attrition. This approach should be articulated to various managerial levels as well as to "rank and file" employees to assure cooperation in productivity measurement and improvement. Massive resistance to a productivity program could cause its failure, therefore the importance of gaining employee support cannot be overemphasized. (The special case of dealing with unionized employees in collective bargaining will be discussed in the following section.)

While fear of job loss may be the primary concern of employees, there are likely to be other fears present as well. One of these is the fear of doing more work and/or of working in a "mechanized" fashion. Effective communication should be used to dispell these fears. It should be emphasized that productivity is not synonomous with more work; instead productivity may be viewed as "working smarter, not harder."[2] Efforts to determine methods to accomplish this should include involvement by employees whose jobs are affected. This will serve to: allay some of the fears of the employees; develop a sense of commitment to the program on the part of employees; provide inputs concerning the best procedure for performing a specified function from those most familiar with that function.

The fear that jobs may become mechanized or overly routinized is related to the concept of job satisfaction (which could also be referred to as the quality of working life). Ideally, one would want to enhance job satisfaction (or at least maintain its level) while increasing productivity. However, it is not entirely clear how this goal may be accomplished. Most studies and practical efforts have tended to concentrate on improvement in only one of these areas at a time. Therefore, tested methodology for improving both productivity and job satisfaction is not available. It might even be argued that gains in one area may only be accomplished at the expense of declines in the other, although this does not represent an established response pattern. Indeed, the general relationship between productivity and job satisfaction is not known.[3] However, it does seem reasonable that efforts to maintain or improve job satisfaction should be included within the goals of a productivity program, and that this might serve to enhance the productivity gains of the program. However, this is likely to be a difficult task due to both the limitations of knowledge in this area and the likelihood that job satisfaction has different meanings to different workers.

The foregoing has outlined some of the major areas of concern which might be grouped under the heading of employee (or labor-management) relations. These are: gaining support for productivity programs and combating employee concerns that productivity improvement will result in job loss, greater amounts of work, or decreased job satisfaction. It seems fairly clear that there is a certain degree of interrelationship between these topics. Gaining support for productivity programs would require successfully resolving the employee fears noted above. It also appears that fear of job loss and increased workload can both be considered subsets of job satisfaction. Thus it seems possible to reduce the issues raised above to simply that of gaining support for productivity programs through maintenance or expansion of job satisfaction. Some of the major aspects or potential problem areas related to this goal will be outlined below, as well as some possible management approaches to their solution.[4]

Perhaps the first major job satisfaction issue to consider is job security, or fear of job loss. As noted above, this can be dealt with by clearly communicating a "no layoff" policy--stating that employee reductions, if any, will occur through attrition and reduced hiring. The means of solving this problem is simply appropriate use of communication--through management-employee discussions or meetings, through union leadership, through the media, or by any other appropriate channels of communication.

A second major element of job satisfaction may be described as control over one's job. This can be affected in different ways by introduction of a productivity program, and because of this it appears to be a complex issue. Not all aspects of job control to be discussed here would be present for any given situation. Some aspects of job control may appear to be in opposition to others, either in general or in specific instances. Thus care must be taken in analyzing the prevailing conditions and taking steps designed to enhance job satisfaction in terms of job control. A productivity program may be seen as a threat to an employee's sense of job control in that it implies some change in work activity will take place, and this change is likely to be instituted at the direction of some "authority" as opposed to being initiated by the employee. One way to avoid this problem is to directly involve employees (or representatives of employees) in the productivity program. This might be accomplished by formation of "productivity committees" at various organization levels (city-wide, agency-wide and possibly at major departmental levels within agencies). The agency and department committees would consist of management and employee representatives who could serve to communicate employee suggestions for productivity improvement and feedback concerning proposals offered or changes previously implemented. The committee approach would serve to maintain a sense of job control on the part of the employee while providing management with ideas concerning productivity improvement from those most familiar with the jobs.

Different employees are likely to have different attitudes concerning job control. Some employees derive considerable satisfaction from being able to regulate their own work, while others prefer less independence. The former group are more likely to derive satisfaction from working with productivity committees and/or actively suggesting job changes. Employees in this group in management or supervisory positions would probably derive increased job satisfaction if productivity improvements were part of a "management by objectives" program--that is, where managerial and supervisory employees play a mutually active role in defining goals for their departments or divisions. Therefore, utilizing management by objectives (or other participatory management approaches) as one of the methods of achieving productivity improvement is likely to increase job satisfaction as well as the sense of commitment felt by some employees.

As was noted above, some employees derive satisfaction from not having much control over their jobs. The following suggestions should serve to maintain (or increase) job satisfaction of these employees as well as helping to assure overall understanding and acceptance of the productivity program. First, sufficient time should be allowed for all stages of the productivity program. While productivity improvement may be perceived as a priority project, it should not be instituted on a "rush" basis in order to avoid deterioration of job satisfaction. Related to this, productivity directives and any standards that might be set should be stated as clearly as possible to avoid confusion which would also tend to reduce satisfaction. In those instances where extensive job change will take place, perhaps due to introduction of new equipment or because of job redefinition, training programs should be provided for employees affected by such changes. The above group of suggested actions should prove helpful in maintaining and/or increasing job satisfaction for most employees, particularly those with needs for clear direction and control from others.

Another potential job satisfaction problem mentioned earlier is the fear that productivity improvement might result in harder work and/or heavier workloads. It was pointed out that communicating the idea that productivity means working "smarter" rather than harder should dispell some of the fears related to this viewpoint. In addition, encouraging active participation of employees will serve to show them they have some control over the extent to which they will be able to work "smarter." Another topic indirectly related to this is job recognition and reward. These are important elements of job satisfaction, and tying rewards (monetary or otherwise) to productivity improvement should serve to increase job satisfaction in general and particularly in the case of those fearful of working harder. Merit pay raises and/or bonuses could be linked to meeting or surpassing productivity goals. "Prizes" could be awarded for particularly useful suggestions. Other forms of recognition-citations, press releases, etc.--could also be utilized to encourage and reward participation and to enhance job satisfaction. At the same time, care should be taken that "rewards" of some sort are not inadvertently distributed to those who are not meeting standards. Indeed, disciplinary action might be instituted for those failing to achieve specified minimum levels of improvement.

The above outlines some of the ways management can act to enhance job satisfaction of public employees. The discussion has ignored the possible existence (and influence of) public employee unions. If these did exist, it is likely that some of the actions suggested might not be possible, or might require modification. However, in cities where unions are present it is important to involve unions in the productivity program along the participatory lines suggested above for employees. (The topic of productivity bargaining will be addressed in the following section.)

The discussion thus far has centered on management-labor relations. While these are of considerable importance, this focus ignores two other groups of significance in the public sector--politicians and citizens. Politicians may be regarded to some extent as "top management," and thus are included to some degree in the foregoing discussion. However, since it would be possible for political leaders to avoid direct involvement as managers, it seems appropriate to single them out as a group here. Political leaders should become actively involved in, and supportive of, productivity programs. Their influence and visibility should be used to enhance the image of total commitment to productivity improvement. Their involvement will further strengthen the perceived degree of management support, and would appear to be particularly useful in dealing with unions.

Citizen involvement should also be sought for several reasons. First, citizens may be able to offer valuable suggestions for improving productivity, and should be encouraged to do so. This could occur informally, perhaps by communicating willingness to consider all suggestions received, and/or by offering recognition or "awards" of some kind to particularly good suggestions. On a more formal basis, citizens might be included in a city-wide productivity improvement committee, including representatives of city agencies and labor; or an advisory committee composed of citizens only might be formed. In any event, it should be made clear that the city government exists to serve its citizens, and productivity improvements are being sought in their behalf. Keeping citizens informed of the productivity program and its achievements by use of the media may also serve as one way of increasing job satisfaction. Employees may feel they (or the positions they hold) will receive greater respect and recognition as a result of citizen awareness of the program, and regard this as an indirect "reward."

The discussion thus far has focused on obtaining support from various groups involved in or affected by a productivity program. Another kind of support deserves brief mention here--information or assistance. The government official introducing a productivity program should keep in mind that others have done the same, and that it is possible to learn from their successes and failures. Information about productivity programs is available from national associations,[5] and possibly from one's own state government or local governments in the immediate area that may have conducted productivity programs of their own. Although this research might be seen as time consuming, in the long run it could prove to be quite valuable.

The above section has introduced some managerial aspects of gaining support for a productivity program. The emphasis has been on labor-management relations, and it should be clear from the discussion that this topic is quite complex, and that no simple "formulas" can be offered to fit all situations. An additional aspect of labor-management relations, productivity bargaining, is outlined briefly in the following section.

Productivity Bargaining

The focus of this section will be on a more specific aspect of labor relations--the problem of productivity bargaining in those locations where public employees are unionized. Before outlining some of the considerations involved in productivity bargaining, the term itself should be clarified. As it is used in this discussion, productivity bargaining refers to any collective bargaining situation between representatives of public labor unions and government management in which productivity improvement is one of the items subject to negotiation.

In general, productivity bargaining will probably deal with one or both of the following issues: changes in work rules or procedures designed to increase productivity, and linkage of wage increases to specified, measurable gains in productivity. In both cases (although more readily apparent in the latter), a major issue involved is tying wage gains to productivity improvement. Thus it is of considerable importance from the management perspective that wage increases negotiated with public employee unions do not exceed the savings generated by the productivity improvements obtained. While this may appear rather obvious, it is likely to be difficult to accurately estimate cost savings of productivity improvement, or, in the case where work changes are accepted by public employees in exchange for higher wages, it is not always possible to know in advance that such changes definitely will increase productivity. Combined with this difficulty is the apparently widely accepted belief that wage increases associated with productivity agreements should be larger than "normal" salary increases.[6] Thus it is possible for a government to agree to wage increases that exceed the value of productivity gains, or, in some instances, productivity gains may not occur at all.[7] The point to be emphasized is that public managers must be aware of and evaluate the relationship between unit cost and productivity increases in the case of productivity bargaining. Indeed, it has been suggested that poor public management may be a major part of the "problem" of dealing with public unions, and that better management would result in higher productivity in general as well as better bargaining.[8]

It is beyond the scope of this section to attempt to specify the "best" or "correct" approach to productivity bargaining. The intent here is simply to point out that productivity bargaining would undoubtedly result in costs that will offset productivity savings, and that care must be taken that such costs do not exceed the benefits of productivity improvement, a topic which will be discussed more generally below.

Costs and Benefits of Productivity Programs

The objective of this section is to present a brief overview of the general costs and benefits of undertaking a productivity program. It may be desirable for the city contemplating a productivity program to undertake a formal benefit-cost analysis to determine whether projected benefits exceed the costs of the program. The current popularity of productivity improvement tends to overshadow the associated costs and gives the impression that productivity is automatically a money-saving device. While this might be true in many cases, it would appear reasonable that each city decide for itself whether a productivity improvement program would have a favorable benefit cost ratio given the individual circumstances facing that city. The intent of this discussion is not to indicate how benefit-cost analysis should be performed, but to suggest some of the major costs and benefits likely to be associated with productivity programs.

The primary benefit to be obtained from productivity programs is simple to define but difficult to measure. The major benefit is anticipated cost reduction due to productivity gains. This will hopefully be accomplished without reduction in the quality of service provided (which will be discussed further in Chapter 4). Estimating dollar amounts for this benefit is difficult, and this task is beyond the scope of the discussion here.

Major costs associated with productivity programs can be grouped into two categories. One group is costs associated with productivity measurement, the other is costs associated with productivity improvement. Costs within the former group are fairly obvious, but may add up to significant expenditures. These costs include expenditures associated with introducing the program (largely personnel expenditures) and costs of collecting and analyzing data (which would include labor expense and possibly computer time). In addition to monetary outlay, these aspects of the program may prove to be "expensive" in terms of the amount of time required for performance. An indirect cost associated with productivity measurement might be employee discontent, which could be associated with reductions in the quantity or quality of work performed. However, if the program is successfully introduced in a manner that enhances job satisfaction, this cost should not be anticipated.

The second grouping of costs is associated with improving productivity. This can be viewed in terms of labor and equipment costs. Work changes designed to improve productivity might only be agreed upon in exchange for wage gains, particularly in cases where unions are present and productivity bargaining occurs. Thus the cost reductions of productivity gains will be offset to some degree by wage increases. The second cost category is related to the likelihood that productivity gains might only be achieved through introduction of new technology or capital equipment, (which is likely to be an expensive undertaking), as has generally been the case with respect to private sector productivity gains.

The above briefly outlines some of the cost considerations that should be considered along with the benefits expected. Consideration should be given to the question of whether the city can afford the costs involved with productivity improvement. In particular, if improvement is likely to require investment in new capital equipment that the city cannot afford, then it should be asked whether it is worthwhile for the city to undertake productivity analysis if costs of improvement cannot be met. This is the type of question that should be brought out and considered within the benefit-cost framework.

This chapter has focused on organizational and managerial aspects related to productivity measurement and improvement. Suggestions have been made regarding ways of dealing with some potential problem areas. Aspects of implementing productivity measurement and topics related to productivity improvement will be discussed in the following chapter.

ENDNOTES

1. The term "city" will be used here in a generic sense to refer to any level of local government.

2. First Western Conference on Municipal Productivity and Quality of Working Life, "Partners for Productivity." Public Productivity Review 1 (June, 1976): 6.

3. Raymond A. Katzell, et. al., Work, Productivity, and Job Satisfaction (New York: The Psychological Corporation, 1975): 5.

4. Material presented draws heavily from Katzell, Work, Productivity, and Job Satisfaction, pp. 11-40 and First Western Conference, "Partners for Productivity", pp. 4-22.

5. For example, the International City Management Association publishes a bi-monthly Guide to Management Improvement Projects in Local Government which lists activities undertaken by local government to improve management, including productivity projects.

6. Raymond D. Horton, "Productivity and Productivity Bargaining in Government: A Critical Analysis." Public Administration Review 36 (July/August 1976): 408.

7. Ibid., pp. 409-410.

8. Sumner M. Rosen, "Public Service Unions and Public Services" in Improving the Quality of Urban Management, ed., Willis D. Hawley and David Rogers (Beverly Hills, Calif.: Sage Publications, 1974), pp. 576-577.

CHAPTER 4. PROCEDURAL ASPECTS OF PRODUCTIVITY PROGRAMS

Objectives

The objectives of this chapter are to introduce procedural steps in introducing a productivity program, and to make the participant aware of major aspects of productivity improvement. Procedural matters to be discussed include: introduction of the program in selected places; choice of productivity measures; and aspects of service quality. Following this, the general goal of improving productivity is discussed, along with measurement techniques helpful to this end. Estimated time for this section in a class setting is 2-3 hours.

Selective Introduction

In those cases where a productivity program is introduced on a citywide basis at the same point in time, selection of services in which to introduce the program is not a matter of concern. This section will focus on introducing productivity programs on a limited scale--that is, in selected agencies as opposed to introduction in all city agencies simultaneously. This approach might be taken for two primary reasons: 1) as an experiment, to determine whether productivity programs should be introduced on a broader scale, and/or to overcome employee resistance; 2) because of budgetary limitations. Aspects of introducing a limited program under each of these circumstances will be discussed briefly here.

A productivity program might be introduced in selected agencies either to determine whether it is a worthwhile undertaking or to convince resistant or doubtful public employees that it is worthwhile. In these cases, the limited introduction might be regarded as a "showcase" approach. The intent under these circumstances is to show that productivity measurement and improvement are possible and do not necessarily involve reduction in job satisfaction or other negative effects on employees. Thus considerable care should be taken in selecting a showcase agency in which these conditions can be, and are, fulfilled. Best results will probably be obtained in areas where service output is most easily measured, such as trash collection. The successful introduction of the productivity program in the showcase agency is meant to generate enthusiasm and support in other agencies in which productivity programs will be introduced at a later time.

Productivity programs might also be implemented on a limited scale because of budgetary constraints; the cost of data gathering and analysis in all agencies at once may exceed budgetary limits at a given time. In this case, the problem may be defined as selecting the agencies in which the program should be initially located. It would appear reasonable that the agencies that seem in greatest need of productivity improvement should be selected; determining which agencies meet this criteria will be addressed here. Agencies in greatest need of productivity improvement could be determined as those that appear to have had declines in productivity, or those where productivity gains are considerably lower than gains in other agencies. Agencies exhibiting these patterns can be determined (at relatively low cost) by use of the fiscal approach to productivity measurement set forth in Capter 2. This analysis can be performed for each city agency, and those appearing to have low levels of productivity can be selected for further productivity measurement (in the sense of outputs/inputs) to verify the findings of the fiscal approach. In this manner, efforts can be directed toward improving productivity in those agencies likely to produce the greatest benefits for limited resource investments.

It should be pointed out that a limited approach to productivity implementation is not suggested as the preferred approach; it is offered as an alternative which might be useful under circumstances when full-scale introduction of a productivity program is not possible or desired.

Choice of Productivity Measures

This section will discuss several aspects involved in selecting measures to be used in the productivity program. The preferred choice approach will be considered first. The question of general choice of productivity measures will follow. Finally, the matter of data availability will be discussed. Obviously, the latter has a major impact on productivity measurement, but the former will be discussed on the assumption that some choice may be possible.

One of the first steps in attempting to measure productivity change for any service is to determine the goals of that service. To be useful for productivity measurement, the goals should be identified in a quantifiable manner. This may not be as simple a task as would appear, and may require discussions with departmental personnel to discover and quantify goals of each particular department.

Each service can be seen as having several goals or objectives. Not all of these are readily quantifiable, especially those that are preventive in nature. However, there are invariably one or more direct outputs produced by the agency related to achieving each goal. In most cases, these direct outputs will consist of quantifiable activities. (Some may be more meaningful in quantitative terms than others.) Note that the measurement focus is on direct outputs of a final nature--not intermediate outputs, such as clerical or maintenance tasks.

Obviously, one could run into difficulty by selecting too many productivity measures. There are no firm rules on how many indicators to select for any given service. It seems clear that one should identify major goals of each department, and select at least one quantifiable indicator for each of these. If there is more than one major direct output associated with a goal, then multiple productivity indicators should be used. The key word in the above discussion, of course, is "major." It is up to each manager to decide what goals are "major" enough to include in the productivity measurement program, given the possibly conflicting constraints of need for a comprehensive program, budget and time limitations, and need to maintain sufficient simplicity so results may be interpreted with relative ease.

The above outlines the selection of preferred measures to utilize--those most closely related to service goals. The next question is how to quantify them. Chapter 2 discussed various approaches taken to measuring productivity and reached the conclusion that output/input ratios were the preferred method of measurement. Therefore, the direct output could be shown as a ratio to one or more inputs. Use of labor as the input ratio is probably the most common approach, followed by use of expenditure. The potential problems of interpretation of productivity change when labor is used as an input was discussed in Chapter 2. However, there is also the possibility of interpretation difficulty with the use of expenditure unless all relevant dollars are included. This would include employee fringe benefits, related maintenance costs, facility and equipment costs, depreciation, and indirect and shared joint costs.[1] Clearly, use of accurate expenditure data is not as simple as it might first appear, and a more accurate estimate of relevant labor hours might be far easier to calculate. However, it must be assumed that each city undertaking a productivity program will want to determine for itself how productivity will be measured. Several considerations are involved in making such a choice. First, in order to determine whether productivity has increased a base year figure is required, preferably for the current or most recently completed year, unless there is some particular reason for using an earlier base. The data available for this will obviously be restricted by current data collection procedures, and may not fit the output/input framework. Thus, if the city wished to determine productivity gains one year from the present, they might have to use an "outputs only" or "inputs only" approach if that is all that current data permits, or perhaps they might use the fiscal analysis approach if neither output nor input data are available. Thus short-run productivity measurement is restricted by past and present data collection procedures. In terms of a longer run approach to productivity measurement, the city can decide what types of data it wants to collect and begin collecting that sort of data so future analysis may be performed in terms of the preferred productivity measurement approach. Of course, data collection is not inexpensive, and cost aspects should be kept in mind when determining future collection methods.

It should be noted that the term "city" has been used above to represent the centralized decision-maker. However, agency and department level managers should have input in this process as they are most familiar with both the types of data currently available in their respective agencies or departments, as well as the potential for collecting other types of data in the future. Thus they could indicate that a suggested future measure might be difficult or impossible to quantify, thus enabling management to select an alternative measure for future collection. In addition, discussion with agency and department managers might indicate that different types of measures might have to be used in different agencies and/or departments. The duties performed by some agencies may simply not be amenable to measurement in output/input terms. Thus any deviations from city-wide productivity measurement methods should be agreed upon before the productivity program goes into effect.

Once current and future measurement policies are settled, current data should be compiled and analyzed in accordance with the chosen indicators. Ideally, this should be done at the agency level, or perhaps by departments within agencies, since the major portion of necessary data is likely to be available at those levels. However, an overview of the types of data generally available and the form in which they might be found will be presented here as a guide.

Output data would generally be available in terms of the number of clients served (e.g., the number of welfare cases or hospital patients) and/or the quantity, and possibly types, of services rendered (e.g., the number of fires extinguished or the number of parking tickets issued). This type of data might be found in annual reports or statistical reports issued by the respective agencies, or perhaps in a comprehensive report issued by the city government. However, it is possible that this data may not have been compiled and published, and might only be available in agency files, for example. Some output data might only be available at the "branch" level (e.g., police precincts, fire houses, or neighborhood social service offices). The degree of difficulty required to collect and analyze such output data clearly increases in accordance with the location of the data as outlined above.

Input data, such as the number of employees or expenditure data, might be found in the same locations as output data. However, most input data is also likely to be available in the budget and expenditure records of individual agencies as well as the city budget. Therefore, it is likely to be easier to locate input data of some kind as opposed to output data. However, it should be pointed out that budget data do present some problems. They may be too aggregated to be useful (e.g., expenditures or employees may be shown for the whole agency or by major departments only while desired data may be for lower levels). In addition, budget figures may refer to the budget requested, but may not accurately reflect how the budgeted amounts were really spent.

The availability of desired data and the ease of collection are likely to vary considerably by location. The topic has been included here as a general guide to the considerations and difficulties involved in data gathering and analysis.

Quality of Public Services

One aspect related to both productivity measurement and improvement is the quality of public services. When measuring changes in productivity, care must be taken that the unit of output measured remains at a constant level of quality. Otherwise, the change that has occurred will not truly reflect productivity change if the quality of service delivered has changed. For example, a sanitation department might seek to improve productivity by requiring residents to use plastic trash bags instead of other containers. This would serve to increase the amount of refuse collected per labor hour. But this cannot be considered purely a productivity improvement because the nature of the service has changed--citizens are now performing an additional chore. In effect, the quality of service has decreased in this case.[2] Therefore, some kind of quality controls must be developed and maintained throughout the course of productivity measurement.

Quality should also be considered when changes in service are contemplated. It may be argued that productivity may be broadly interpreted to include quality, and that care should be taken that changes introduced to improve productivity do not cause a reduction in service quality at the same time (unless, of course, this trade-off is recognized and agreed upon as acceptable under the circumstances). Like the outputs to which it is related, public service quality is a concept that is difficult to define and measure. Quality of service can be thought of as incorporating both the concepts of "excellence" and "effectiveness." The latter may be considered in terms of the degree to which a service achieves its intended purpose. Aspects of quality related to the concept of excellence include: lack of negative externalities; adequate supply of the service; equitable distribution; manner of service provision (e.g., courtesy and respect on the part of public employees, etc.); response time; and possibly other aspects which might vary according to the type of service.[3] It should be clear from scanning this list that some of the quality aspects noted will be difficult to measure. While a full review of these difficulties and suggested ways to measure service quality is beyond the scope of this discussion, some major points will be outlined here to help clarify the general concept of service quality.[4]

Effectiveness may be the most important quality aspect of public services. In order to measure effectiveness, the goal of the service must be identified. Goals may be thought of in terms of consequences. One goal of police service would be to prevent or reduce crime, and effectiveness with respect to this goal might be measured in terms of crime rates (an inverse indicator). Effectiveness measures for some services might entail the use of measurement techniques other than simply using generally available statistics. For example, the effectiveness of sanitation service in terms of street cleaning could be measured by use of a "street cleanliness index," which is determined by comparing city streets to photographs representing various degrees of street cleanliness. The streets are "rated" in terms of the photograph that most closely resembles the actual condition.[5]

Negative externalities of public services might include pollution (including excessive noise) associated with service provision. This could be measured in terms of citizen complaints and/or citizen surveys, as well as by pollution monitoring devices. Adequate service supply may be difficult to quantify, and could include concepts of both the number of people served and the range of services provided. The former might be measured in terms of the proportion of eligible population that is actually served (e.g., the percentage of poor that are recipients of welfare or other social service assistance).

Equitable distribution of services involves consideration of whether services are equally distributed among population groups and/or geographic locations, with due consideration given to variation in need for the services. This is a complex problem, as one must question whether equality refers to inputs, direct outputs, or consequences, or a combination of these, as well as considering their quality variations. The practice of racial discrimination in provision of public services has been brought to the courts in recent years, which indicates the importance of this aspect of service provision.[6] However, an agreed-upon method for measuring equality of service distribution has not emerged thus far. It would appear reasonable to assume that measurement of equality in service provision would vary somewhat according to the service under analysis.

An additional quality indicator may be referred to as the general attitude with which the service is provided (e.g., the care, courtesy, and respect shown in its delivery). This could be measured by citizen complaints or surveys. A final indicator is response time. This is particularly important in the provision of police and fire services, where time may be a crucial factor affecting the quality and effectiveness of the service rendered. The topic of service quality has been briefly reviewed here for the purpose of introducing this concept as one to be considered in conjunction with public service productivity.

As noted above, changes designed to improve produtivity might have an adverse impact on service quality in some cases. It would be preferable to improve productivity without decreasing quality, but this may not always be possible given fiscal limitations confronting a particular city. In some cases, therefore, a conscious decision concerning trade-offs between quality and productivity may be necessary.

Goals of the Productivity Program

The previous sections have dealt with procedural concerns primarily related to productivity measurement. At this point, it seems appropriate to bring up the question of why the measurement is taking place. Clearly, it is not collected for its own sake. The main goal of the productivity program is to improve the efficiency of service delivery. This is another point that should be kept in mind when determining the kind of information to be collected. Other goals are to locate problem areas that need particular efforts toward improvement, and to calculate progress toward specified goals.

While numerous steps could be taken in an effort to increase efficiency, a detailed study of productivity improvement is beyond the scope of this module. However, a measurement-related aspect of productivity improvement will be discussed in the next section, followed by a general discussion of productivity improvement techniques.

Studying the Production Process

Before any steps can be taken toward improving productivity of delivery of a particular service, the production process by which it is provided must first be studied. In most cases, this means the production process of the various major direct outputs of the service agency. In studying the production process, one must look at the steps involved in the actual performance of an activity. Matters that might be considered include: the quantity and organization of the labor involved; the combination of labor and machinery; and the organization of routes (if these are involved). In general, the study of production processes has long been an important part of the fields of industrial engineering and business administration. The manager might wish to refer to basic texts in work study and/or time and motion study for more detailed information on various aspects of studying the production process.[7]

Analysis of production can be considered in terms of both a broad and narrow perspective. The broad perspective involves analysis of the methodology involved in performing the work--that is, the various steps or processes necessary to perform a specific activity or subset of an activity. A narrower analytic perspective may be termed work measurement, which involves examining the amount of time spent in performance of different tasks. The terms method study and work measurement may be used to refer to both the examination of current practices and the development and application of improved methods and/or standard work times. The terms will be utilized here in accordance with the former meaning (i.e., in an analytical sense). The emphasis herein will be on studying work method as opposed to work measurement, as the latter is generally directed toward establishing standard times for performing specified jobs, an approach which may be more suitable for production of tangible goods than for most services.

Method study may be performed by decomposing the production process into its individual components. This may be done in a diagrammatic fashion by use of a process chart. Such a chart indicates the chronological sequence of events involved in a particular production process. The service agency as a whole is not included in one chart. Major functions of the agency are considered separately, and these functions (or activities) are decomposed in the operation process chart. The chart may use symbols to indicate standard types of events (such as: inspection, operation, transport, etc.); however, a chart could be constructed without use of symbols. The chart may be composed of major operations only, which may be referred to as an outline chart, or it can be drawn up in greater detail. A hypothetical outline operation process chart for patient examination at a public health center is presented below as an example of the process chart format:

Sample Outline Operation Process Chart
Public Health Center

Medical Examination

1) Patient folder removed from file.
2) Patient history reviewed.
3) Patient interviewed by doctor.
4) Physical examination of patient.*
5) Medication prescribed.
6) Patient folder returned to file.

*This could be listed in terms of specific activities, such as blood pressure taken, x-ray taken, etc.

Supportive or subsidiary activities may be associated with a process in such a way that the results of these activities enter the main process at some point after its start. These supportive activities may be outlined in process form in the left side of the process chart page, with entry indicated at the appropriate point in the main process. Using the previous example, assume a certain type of blood test is performed on the patient prior to the beginning of the examination, and the results of this test are brought to the doctor during the examination. The process chart for this sequence could be shown as follows:

Sample Outline Process Chart
Public Health Center

Blood Test

1) Blood sample drawn.
2) Laboratory analysis of sample performed.
3) Analysis written up.

Medical Examination

1) Patient folder removed from file.
2) Patient history reviewed.
3) Patient interviewed by doctor.
4) Physical examination of patient.

8) Blood test results reviewed.
9) Medication prescribed.
10) Patient folder returned to file.

It should be clear from the examples given that the production of an entire agency is not included in one chart. Instead, individual services are decomposed into major functions, and each of these services is analyzed in a separate chart. The process chart approach could be utilized to study only major services, or it could be utilized to study the steps performed to produce all activities involved with production of a given service. Thus supportive activities that are consumed within an agency (as opposed to those consumed by the public) may also be analyzed in this fashion. The process chart can be subdivided according to stages of the production process, such as: preparatory activities; major activity; and closure activities (i.e., "clean-up" or "put away" activities). Thus these stages may be examined individually to look for ways of improving productivity.

The process chart can also be prepared from different perspectives. That is, the sequence (or flow) of activity can be recorded in terms of: (1) what the individual worker does, (worker-oriented chart); (2) what happens to material or physical objects (object-oriented chart); and (3) how equipment is used (equipment-oriented chart). The chart can also be prepared to show the flow of activity involving these three orientations combined, which tends to be the case when an operation chart is used. However, the separate perspectives might prove useful in some cases in pinpointing specific steps in the production process that could be changed to enhance productivity.

The above discussion outlines the items that may be included in the process chart. However, the matter of chart preparation (i.e., who prepares the chart) must also be considered. Accuracy of these charts is important as they will be studied to determine productivity-enhancing changes (to be discussed further below). Specific individuals might be designated to prepare charts for each agency, or they might be prepared at a centralized level. Descriptions of the production process can be generated from two major sources, the workers involved in the process (perhaps by logging their actions for a period of time), or observers (who would observe the production process and record the steps involved). Observers might also be used as spot-checkers for worker-recorded processes. Different procedures might be selected for different agencies and/or services. In any case, some kind of training program will be required to explain the process chart concept, the type of information needed, and how it should be recorded in order to obtain the necessary information for those preparing the charts.

While chart preparation is important, the analytic stage is where productivity improvement may be initiated. The analytic, or examination, stage looks at each activity in terms of whether it is necessary, and, if so, whether modifications can be made to improve productivity in performing this activity. The major activity in any given process should be examined first, because if it is determined to be unnecessary and is therefore eliminated, the supportive and terminal activities associated with it will automatically be eliminated, without wasting time considering them individually. Analysis can be performed in two stages. The initial stage focuses on the questions: Why? What? Where? Who? When? and How? The "why" deals with the reason for performing the operation in the first place, and may be seen as considering its relation to a larger goal. "What" deals with the more immediate purpose of the operation--as in what is accomplished. "How" looks at the methodology involved--the physical aspect of the operation. "Where," "when," and "who" basically serve to locate the operation in the larger scheme of things by pinpointing who performs it, where it is performed in a locational sense, and when it is performed in the sequence of events. It is this stage that provides a thorough understanding of the production process and how it is organized. Once these points are identified and their need established, each in turn can be examined to discover alternatives which might be used to achieve the same results. These alternatives can then be analyzed to determine whether any of them might result in improved productivity. The alternative that seems most likely to result in improved productivity as well as appearing acceptable in terms of usage may be identified as the "best alternative." This alternative should be introduced into the production process as soon as possible. The term "best alternative" should not be interpreted as being the alternative offering the greatest productivity gain. This alternative incorporates both feasibility of adopting the alternative (given financial, technological and time limitations as well as restrictions imposed by current labor practices) as well as potential productivity gains.

A suggested examination format is presented here to show the stages of this analysis; a similar format could be used in actual analysis.[8] (See page VI.8.39). The format presents the basic questions outlined

81

ANALYSIS OF ACTIVITY FORM

Stage 1 Examination	Stage 2 Alternatives	
	Possible Alternatives	Best Alternatives
1) Why? Why is this operation performed? What goal is involved?		
2) What? What is the purpose of the operation? Is it necessary?		
3) Where? Where is the operation performed? Why this place?		
4) When? When is it performed in sequence? Why then?		
5) Who? Which person performs the operation? Why this person?		
6) How? How is it done? Why that way?		

above along with some related "why?" questions designed to further clarify the production process. Space is also allowed for possible alternatives to the current production methodology, and for potential "best alternative" to be singled out. The first two questions look at the purpose of the activity under question. The other questions refer to aspects of production that might be altered to increase productivity--such as location, sequence or methodology. This analytic format is presented as a guideline. It is possible that some changes might be made (i.e., eliminating or modifying some of the questions), to better suit particular agencies or services.

This section has concentrated on analyzing the production process involved in providing public services. Examples of how this analysis could be conducted have been provided. The following section will outline ways in which productivity might be improved.

Methods of Improving Productivity

Methods of improving productivity may be grouped into two general categories: (1) Alterations in work rules or methods of production and (2) Technological change. An outline of what is involved in each of these types of change will be presented in this section.

Alterations in work rules and/or methods of production are most closely related to the analysis of the production process discussed in the previous section. Any changes that can be made in the manner in which a service is produced (except those involving different technology or capital equipment, which will be discussed below), may be included in this category. Elimination of unnecessary procedures is one type of methodological change. Having a task performed by one employee rather than two is an example of a work rule change designed to increase productivity (e.g., use of one-man patrol cars as opposed to two-man cars in performance of police patrol service). A change in the sequence or location of various steps in the production process might remove duplication of effort and thus result in increased productivity. Analysis of the production process might result in discovery of relatively simple changes that could result in productivity gains. Of course, it is possible that some changesin work rules or procedures might meet resistance on the part of employees and/or unions, which may make it difficult to introduce all potential modifications identified. However, changes in the production process offer considerable potential for productivity gains, even if agreements regarding implementation must be negotiated with employees or unions. A variety of personnel management activities also fall within this first category. These would include better personnel deployment (i.e., better "matching" between workers and jobs); more and/or better job training; efforts to improve employee motivation; and better enforcement of adherence to existing rules (or, possibly, creation of new ones).

The second major approach to improving productivity has been identified as technological change. This term is being used here to include new types of equipment, and/or substitution of capital (equipment) for labor. While there is considerable potential for improved productivity through technological change, this approach may not be as promising as modifications in production or work rules due to the labor intensive nature of public service production. One type of technological change that has wide applicability is increased use of computers to perform many of the data processing personnel-related functions (such as payroll) associated with local government.

Different types of equipment can be utilized to either enhance productivity of personnel using the equipment or to replace some of the personnel previously performing a particular action, thus freeing them to work on other aspects of the service and thus enhancing overall productivity. An example of the former type of technological change is the development of "slippery water." This refers to water which has been chemically treated to move more rapidly through hoses, and has been used to increase fire fighting productivity. The faster movement of water permits use of smaller, lighter hoses which allow fire fighters to reach the fire location more quickly and therefore extinguish fires in less time.[9] Use of new types of capital equipment to replace labor may be shown by the example of refuse collection systems which use special types of containers which are designed to be lifted and dumped by the truck itself, replacing the need for sanitation workers whose function was emptying refuse containers.[10]

Technology, in the form of computer applications, can also be used to provide better deployment of service personnel, particularly fire personnel in response to a fire alarm based on the probability that the alarm is false. Computer simulation has been used to determine which locations should receive a smaller than "standard" response in terms of fire equipment for an alarm based on previous alarm history for that area. Adaptive response may also refer to varying the response in accordance with the type of fire reported (e.g., an automobile fire as opposed to a house fire), instead of sending the same amount of equipment and personnel to every incident.[11]

An obvious concern regarding changes designed to improve productivity is the matter of obtaining employee acceptance of such changes. (This is somewhat similar to the issues raised in Chapter 2 concerning employee acceptance of a productivity measurement program.) A variety of approaches to improved productivity through employee incentives have been tried by local governments. Among the incentives that have been used are: competition and contests; job enlargement (changes to make a job more interesting, including job rotation, redesign, team efforts, or increased participation); variation in working hours; "task systems" (allowing employees to leave work when assigned tasks are completed regardless of time involved); and monetary incentives, which may be in the form of performance bonuses, output-oriented merit increases, or even piecework systems.[12] The local manager may want to consider some form of incentive system as part of the productivity improvement program.

The discussion presented here has broadly defined methods for improving productivity in terms of change in the production process or technological change. It should be clear that the examples given here represent only a few of the possible changes that could be included under these headings. Many of the potential changes, particularly those related to work rules and production procedures, will be unique in terms of individual locations. This is recognized in the analytic framework presented in the previous section, which allows for individual analysis of major processes involved in providing each service and the stipulation of alternatives for all aspects of each process. This detailed approach encourages attempts to identify a variety of work rules, methods, or technological changes which might improve productivity in the various stages of production of each service studied.

This chapter has reviewed procedural aspects of implementing productivity programs. Items discussed have included both aspects of introducing programs and the general topic of productivity improvement. The latter has been introduced here in a superficial way since this aspect of productivity is beyond the primary scope of this module. However, since the end goal of productivity measurement is productivity improvement, brief mention of some aspects of productivity improvement is appropriate. This topic marks the final discussion in the learning module. However, a case study is presented in the following chapter. The case study is designed to provide experience in the use of various measurement techniques presented earlier in the solution of a productivity measurement problem based on an actual local government setting.

ENDNOTES

[1] For further discussion, see: Harry P. Hatry, "Issues in Productivity Measurement for Local Government," in Productivity in Public Organizations, ed., Marc Holzer (Port Washington, N.Y.: Kennikat Press, 1976), p. 97.

[2] Ibid., pp. 91-95.

[3] Harry P. Hatry, "Measuring the Quality of Public Services," in Improving Urban Management, ed., Willis D. Hawley and David Rogers (Beverly Hills, Calif.: Sage Publications, 1976), pp. 6-7.

[4] Ibid., pp. 6-12.

[5] Harry P. Hatry, Richard E. Winnie and Donald M. Fisk, Practical Program Evaluation for State and Local Government Officials (Washington, D.C.: The Urban Institute, 1973, pp. 93-101.

[6] Most notably in the case of Hawkins vs. Town of Shaw. For a discussion of this, see: Robert L. Lineberry and Robert E. Welch, Jr., "Who Gets What: Measuring the Distribution of Urban Public Services," Social Science Quarterly, 54 (March 1974): 702-705.

[7] For example: Stanley Johnson and Grant Ogilvie, Work Analysis, (London: Butterworths, 1972); J. A. Larkin, Work Study (Berkshire, England: McGraw-Hill, 1969); M. E. Mundel, Motion and Time Study - Principles and Practices (Englewood Cliffs, N.J.: Prentice Hall, 1970); Benjamin W. Niebel, Motion and Time Study (Homewood, Ill.: Richard D. Irwin, Inc., 1972).

[8] The format presented here is based on: J. A. Larkin, Work Study, p.42.

[9] The Urban Institute, The Struggle to Bring Technology to Cities (Washington, D.C.: The Urban Institute, 1971), pp. 31-40.

[10] Ibid., pp. 21-30.

[11] Edward K. Hamilton, "Productivity: The New York City Approach," Public Administration Review 32 (November/December 1972): 790-791.

[12] For a thorough review of employee incentives, see: National Commission on Productivity and Work Quality, Employee Incentives to Improve State and Local Government Productivity (Washington, D.C.: U.S. Government Printing Office, 1975).

CHAPTER 5. CASE STUDIES

Objectives

This chapter concludes the Productivity Measurement curriculum module. The material presented here is the basic data required to perform three case studies. The objective of the case studies is to familiarize the urban manager with productivity measurement by applying methods and techniques introduced throughout the course of this module. It is intended that the case studies be worked on by small groups (3 to 5 people, depending on the size of the entire class), with group discussion and feedback of considerable importance in the learning experience. Each study group will present their approach to measuring productivity, the results obtained, and problems encountered, to the class as a whole. Feedback from the entire class will be solicited. It is estimated that the case studies will require approximately 4-6 hours.

Instructions for Case Studies

Material provided to perform productivity measurement includes a brief overview of "River City," which outlines general population characteristics, and "Annual Reports" for the city's police, fire, and sanitation departments. The material included in these reports is typical of that which would be expected to be readily available for these departments in most cities.

Each group working on these case studies should assume that they are members of a city-wide productivity measurement task force. The functions of the task force are to:

1. Determine the organizational location(s) and framework for an on-going productivity measurement program.

2. Determine how to introduce this program to the various city agencies.

3. Using available data, assess the change in productivity between 1960 and 1970 for the city's police, fire, and sanitation departments.

4. Examine the production process of each of the services provided (to the extent possible).

5. Stipulate any change in data collection for these departments that would be desired for the on-going productivity measurement program.

The "task force" may use any methodology and/or type of measurement it deems appropriate to assess the 1970 productivity position of the three departments. It is suggested that multiple productivity measures be used and the results obtained with different measurement techniques be compared.

"Answer sheets" are provided for each department. These show the numerical answers for productivity indicators, as well as some major elements of the production process involved in performing services. The answers given are not intended to represent the only "correct" answers, however, they do represent the most readily identifiable indicators based on the methodology encompassed in this module. The answer sheets should not be consulted until the group exercises are completed.

AN OVERVIEW OF RIVER CITY

River City is located near a major metropolitan area in the northeast. It experienced considerable population growth between 1960 and 1970, growing from a population of about 222,000 in 1960 to about 295,400 in 1970, a 33 percent increase. The growth in the younger population (children under 18) was the same as overall population growth, increasing from 76,900 in 1960 to 102,200 in 1970. The elderly population increased somewhat less (25 percent), from 20,500 in 1960 to 25,600 in 1970.

Population groups that might have an influence on provision of some public services will be reviewed briefly here. The black population increased substantially during the decade, 64 percent. However, the number of blacks in River City is quite small, increasing from 9,600 in 1960 to 15,800 in 1970. There is a larger foreign-born population, 26,700 in 1970, an increase of 5 percent from 1960. Families headed by females grew somewhat more than the total population (38 percent), with 7,000 such families living in River City in 1970.

River City is a relatively affluent city. The number of families with lower incomes (defined here as $5,800 in 1970) decreased from 11,000 in 1960 to 9,500 in 1970. Approximately 4,000 River City families received some form of public assistance in 1970, compared to about 1,000 in 1960. Higher income families (defined as $17,400 or more in 1970) increased greatly, from 6,600 in 1960 to 18,200 in 1970. A final indicator for River City is employment within the city. This increased almost 10 percent, from 46,800 in 1960 to 51,200 in 1970. It should be noted that many River City residents commute to other nearby cities to work.

River City
Police Department
Consolidated Annual Report
1960 and 1970

General Information

	1960	1970
Total expenditures	$6,454,000	$16,457,000
Total employment	750	1,060
Average salary, entering patrolmen	5,500	9,500

Service Statistics

Crime Statistics

	1960	1970
Total Felonies	1,500	7,800
Murder and non-negligent manslaughter	2	12
Forcible rape	15	30
Robbery	40	340
Felonious assault	100	200
Burglary	600	3,600
Grand larceny - motor vehicles	400	2,000
Misdemeanors	6,700	21,300

Arrests and Summonses

	1960	1970
Total Felonies	530	1,200
Murder and Non-negligent Manslaughter	2	10
Forcible Rape	15	20
Robbery	30	140

Arrests and Summonses Continued

	1960	1970
Felonious assualt	100	120
Burglary	170	250
Grand Larceny of Motor Vehicles	80	150
Misdemeanors	2,000	9,800

Cases Cleared

	1960	1970
Total Felonies	550	1,000
Murder and Non-neglient Manslaughter	2	5
Forcible Rape	12	20
Robbery	20	80
Felcnious Assualt	90	120
Burglary	180	270
Grand Larceny of Motor Vehicles	120	150
Misdemeanors	3,000	11,000

Value of Property Stolen and Recovered

	1960	1970
Total value of property stolen	$815,000	$4,193,000
Total value of property recovered	375,000	1,227,000
Total value of stolen motor vehicles	350,000	1,955,000
Total value of recovered motor vehicles	330,000	1,124,000

River City
Fire Department
Consolidated Annual Report
1960 and 1970

General Information

	1960	1970
Total expenditures	$1,934,000	$7,208,000
Total employment	220	420
Average salary, entering firemen	5,500	9,500

Service Statistics

	1960	1970
Fires Extinguished	3,360	5,800
Commercial	150	200
Residential	270	680
Public Places	30	70
Vacant Buildings	70	120
Miscellaneous	2,840	4,730
False Alarms	500	1,650
Non-fire Emergencies	400	1,200

River City
Sanitation Department
Consolidated Annual Report
1960 and 1970

General Information

	1960	1970
Total expenditures	$2,835,000	$7,515,000
Total employment	400	540
Average salary, entering sanitationmen	5,000	8,600

Service Statistics

Refuse Collection

	1960	1970
Loads Collected	40,300	46,000
Tons Collected	104,700	167,000
Truck Shifts	17,200	21,000
Man days worked	46,700	58,400

Street Cleaning*

	1960	1970
Power Sweeping		
Curb Miles Swept	36,000	39,000
Broom Shifts	2,500	2,900
Manual Cleaning		
Man days worked	2,330	2,300

Snow and Ice Removal**

	1960	1970
Miles of salt spread	6,000	11,000
Tons of salt spread	4,300	14,500
Miles of snow plowed	21,000	6,300
Plowing equipment shifts	1,600	400

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* Curb miles in area = 1,000.

** Inches of snowfall: 1960 = 57"
1970 = 15"

Approaches to Productivity Measurement:
Police Department Case Study Answer Sheet

Fiscal analysis approach to productivity measurement:

Values used in calculations:

$E_2 = 16{,}457{,}000$
$E_1 = 6{,}454{,}000$
$\Delta E = 10{,}003{,}000$

$C_2 = 9{,}500$ (The cost indicator used was average salary for entering patrolmen.)
$C_1 = 5{,}500$

$W_2 = 295{,}400$ (The workload indicator used was total population.)
$W_1 = 222{,}000$

$$\frac{C_2}{C_1} = 1.7,\ \Delta c = (1.7 - 1) = .7$$

$$\frac{W_2}{W_1} = 1.3,\ \Delta w = (1.3 - 1) = .3$$

$$R^* = E_2 - P(E_2) \text{ where } P(E_2) = E_1 \left(\frac{C_2}{C_1}\right)\left(\frac{W_2}{W_1}\right) = 14{,}263{,}340 \text{ and } R^* = 2{,}193{,}660.$$

Formula:

$$\Delta E = R^* + E_1 \left[\Delta c + \Delta c\Delta w \left(\frac{|\Delta c|}{|\Delta c| + |\Delta w|}\right)\right] + E_1 \left[\Delta w + \Delta c\Delta w \left(\frac{|\Delta w|}{|\Delta c| + |\Delta w|}\right)\right]$$

$$10{,}003{,}000 = 2{,}193{,}660 + 6{,}454{,}000\ [.7 + .21\ (.7)]$$

$$+ 6{,}454{,}000\ [.3 + .21\ (.3)]$$

$$10{,}003{,}000 = 2{,}193{,}660 + 6{,}454{,}000\ (.847) + 6{,}454{,}000\ (.363)$$

$$10{,}003{,}000 = 2{,}193{,}660 + 5{,}466{,}538 + 2{,}342{,}802.$$

Divide both sides of the equation by 10,003,000:

$$1 = .219 + .546 + .234.$$

Multiply by 100:

$$100 = 21.9 + 54.6 + 23.4.$$

Thus, 54.6 percent of change is attributed to cost, 23.4 percent to workload and 21.9 percent to productivity/quality changes. The positive residual value means that actual expenditure in 1970 was higher than anticipated expenditure. This indicates a possible decline in productivity or a possible increase in service quality or a combination of changes in the two. Further analysis may give some indication of which of these is more likely, therefore this question will be discussed below after calculating other productivity indicators.

Some output/input productivity indicators may also be calculated from the data included in the police department report. These are shown below.

	1960	1970	% Change
Felonies per employee	2	7	250%
Misdemeanors per employee	9	20	122%
Felony arrests per employee	1	1	---
Misdemeanor arrests per employee	3	9	200%

In considering "crimes per employee," it should be pointed out that the output measure is really crimes investigated. It is assumed that all crimes reported are investigated to some degree, and that the investigatory function of the police is a major direct activity. The above indicates that productivity in investigation increased considerably between 1960 and 1970. Arrests may also be considered an output indicator. It can be seen that productivity in felony arrests did not change over the decade, while it increased considerably for misdemeanors. It should be pointed out that the employment figures are overstated in both cases, as only total employment data were available, which includes headquarters and other personnel not likely to be directly involved in crime investigation or arrest.

Several indicators of police effectiveness might also be calculated from the data given, such as the proportion of cases "cleared" (i.e., considered solved) in each category, as well as the proportion of stolen property recovered. This will be presented below because they are of importance, but it should be emphasized that they are not productivity indicators. However, they might be viewed as quality indicators to a degree.

	1960	1970	% Change
Proportion of cases cleared			
Felonies	36%	13%	- 64%
Murder and non-negligent manslaughter	100	42	-.58
Forcible rape	80	67	- 16
Robbery	50	24	-.52
Felonious assault	90	60	-.33
Burglary	30	8	- 73
Grand larceny-motor vehicles	30	8	- 73
Misdemeanors	45	52	+ 16
Proportion of stolen property Recovered			
All stolen property	46%	30%	- 35%
Motor vehicles	94	57	- 39%

It appears clear from the above that effectiveness in clearing cases (i.e., "solving" crimes) and recovering stolen property has declined considerably over the decade, with the exception of an increase in crime clearing effectiveness in the misdemeanor category.

The productivity measures calculated above may be used to try to clarify the results of the fiscal analysis model. It appears that the results obtained can best be analyzed in terms of major crime categories, therefore, this approach will be taken here. Felonies are the most serious crimes. The number of felonies and productivity in their investigation increased considerably during the decade. However, arrest productivity did not change at all, and clearance rates, which may be considered to be quality indicators, decreased substantially for most felony categories. In addition, the proportion of stolen property recovered (much of which falls within the felony category), also decreased considerably. Misdemeanors (less serious crimes), however, show substantial productivity gains in investigations and arrests per employee, as well as a quality improvement in the proportion of cases cleared.

The divergent pattern for the two different crime categories makes it difficult to clarify the positive residual value in terms of quality and productivity. Both quality and productivity decreased with respect to felonies, but both increased with respect to misdemeanors. This conflicting mixture is reflected in the residual term, and it does not appear feasible to clarify the residual term further without additional data.

The production process for police services is likely to be quite complex to analyze since it varies considerably according to different circumstances. Some possible major elements of the production process for primary police services are offered here as a guideline in checking the exercises performed. However, it is not suggested that these examples are complete.

Service: crime control. Elements of production process: actual foot or automobile patrol. This is one of the more difficult services to define a production process for, as considerable variation in what officers do on a patrol is to be expected because of the variation in events to which they might have to respond.

Service: crime investigation. Elements of production process: officers go to scene of crime; question victims and/or witnesses; search for evidence; return to station house; make up file on incident; search existing files for similar crimes which might help identify suspect. Variations include: making an arrest if suspect is identified and is found at the scene of crime; seeking out and arresting suspect if suspect is identified but not at scene of crime. Other variations are possible.

Service: arrests. Elements of production process: suspect may be arrested at scene of crime or as a result of investigation. Following arrest, the suspect must be booked, photographed and fingerprinted, and questioned. A report of the arrest must be made. Stolen property recovered must be identified and an attempt to find rightful owner made. Property must be turned over to property clerk who will inventory it and estimate its value.

Approaches to Productivity Measurement:
Fire Department Case Study Answer Sheet

Fiscal analysis approach to productivity measurement:

Values used in calculations:

$E_2 = 7{,}208{,}000$
$E_1 = 1{,}934{,}000$
$\Delta E = 5{,}274{,}000$

$C_2 = 9{,}500$ (The cost indicator used was average salary for entering firemen.)
$C_1 = 5{,}500$

$W_2 = 295{,}400$ (The workload indicator used was total population.)
$W_1 = 222{,}000$

$$\frac{C_2}{C_1} = 1.7,\ \Delta c = (1.7 - 1) = .7$$

$$\frac{W_2}{W_1} = 1.3,\ \Delta w = (1.3 - 1) = .3$$

$R^* = E_2 - P(E_2)$ where $P(E_2) = E_1 \left(\frac{C_2}{C_1}\right)\left(\frac{W_2}{W_1}\right) = 4{,}274{,}140$ and $R^* = 2{,}933{,}860$.

Formula:

$$\Delta E = R^* + E_1 \left[\Delta c + \Delta c \Delta w \left(\frac{|\Delta c|}{|\Delta c| + |\Delta w|}\right)\right] + E_1 \left[\Delta w + \Delta c \Delta w \left(\frac{|\Delta w|}{|\Delta c| + |\Delta w|}\right)\right]$$

$$5{,}274{,}000 = 2{,}933{,}860 + 1{,}934{,}000\ [.7 + .21\ (.7)] + 1{,}934{,}000\ [.3 + .21\ (.3)]$$

$$5{,}274{,}000 = 2{,}933{,}860 + 1{,}934{,}000\ (.847) + 1{,}934{,}000\ (.363)$$

$$5{,}274{,}000 = 2{,}933{,}860 + 1{,}638{,}098 + 702{,}042.$$

Divide both sides of the equation by 5,274,000:

$$1 = .556 + .311 + .133.$$

Multiply by 100:

$$100 = 55.6 + 31.1 + 13.3.$$

In this case, 31.1 percent of change is attributed to cost, 13.3 percent to workload, and 55.6 percent to productivity/quality changes. Thus it appears that either productivity has decreased or quality has increased or some combination of changes involving these aspects of fire service has occurred. This may be explored further following the calculation of other productivity indicators.

Some output/input productivity measures that may be calculated from the data available are:

	1960	1970	% Change
Fires extinguished per employee	15	14	- 1%
False alarms per employee	2	4	+100%
Non-fire emergencies per employee	2	3	+ 50%

The major fire department activity, fire extinguishment, shows a slight decrease in productivity. False alarms, while not a true activity measure, were included here because they represent a significant part of fire department workloads. Productivity in these and in responses to non-fire emergencies increased substantially. However, it should be noted that the input measure is probably overstated in terms of actual input, as total employment includes headquarters personnel, etc. that are not likely to be directly involved in fire fighting and similar activities.

The above indicators may be used in an attempt to explain the residual term previously calculated. It can be seen that the major department activity had a slight productivity decrease, while two others had major productivity gains. It was not possible to calculate any quality indicators from available data. Because of the substantial size of the residual term, however, it would seem that a considerable gain in quality of fire service occurred. This might be related to additional expenses related to purchases of new equipment, for example. In an actual urban analysis, an attempt should be made to determine if such purchases were made.

Some examples of major elements in the production process of fire services are included here as guidelines for the exercise suggested for the case study:

Service: fire extinguishment. Elements of production process: after alarm is received, firemen equip themselves and travel to scene of alarm. Fire is extinguished, fire cause is established and crew returns to fire station. Report is filed. Variations on this would occur if persons had to be rescued and/or if injured persons had to receive emergency first aid.

Service: non-fire emergencies. Elements of production process: after alarm is received, firemen equip themselves and travel to scene of alarm. Nature of emergency is determined and assistance rendered. Crew returns to fire station, and report is filed.

Approaches to Productivity Measurement: Sanitation Department Case Study Answer Sheet

Expenditure analysis approach to productivity measurement:

Values used in calculations:

$E_2 = 7{,}515{,}000$
$E_1 = 2{,}835{,}000$
$\Delta E = 4{,}680{,}000$

$C_2 = 8{,}600$
$C_1 = 5{,}000$

(The cost indicator used was average salary for entering sanitationmen.)

$W_2 = 295{,}400$
$W_1 = 222{,}000$

(The workload indicator used was total population.)

$$\frac{C_2}{C_1} = 1.7,\ \Delta c = (1.7 - 1) = .7$$

$$\frac{W_2}{W_1} = 1.3,\ \Delta w = (1.3 - 1) = .3$$

$$R^* = E_2 - P(E_2) \text{ where } P(E_2) = E_1 \left(\frac{C_2}{C_1}\right)\left(\frac{W_2}{W_1}\right) = 6{,}265{,}350 \text{ and } R^* = 1{,}249{,}650.$$

Formula:

$$\Delta E = R^* + E_1 \left[\Delta c + \Delta c \Delta w \left(\frac{|\Delta c|}{|\Delta c| + |\Delta w|}\right)\right] + E_1 \left[\Delta w + \Delta c \Delta w \left(\frac{|\Delta w|}{|\Delta c| + |\Delta w|}\right)\right]$$

$$4{,}680{,}000 = 1{,}249{,}650 + 2{,}835{,}000\ [.7 + .21\ (.7)] + 2{,}835{,}000\ [.3 + .21\ (.3)]$$

$$4{,}680{,}000 = 1{,}249{,}650 + 2{,}835{,}000\ (.847) + 2{,}835{,}000\ (.363)$$

$$4{,}680{,}000 = 1{,}249{,}650 + 2{,}401{,}245 + 1{,}029{,}105$$

Divide both sides of the equation by 4,680,000:

$$1 = .267 + .513 + .220$$

Multiply by 100:

$$100 = 26.7 + 51.3 + 22.0$$

In this case, 51.3 percent of change is attributed to cost, 22.0 to workload, and 26.7 to productivity/quality changes. Thus it appears that either productivity decreased or quality increased, or some combination of the two occurred.

Productivity measures in the form of outputs/inputs may be calculated from data provided in the annual reports:

	1960	1970	% Change
Refuse Collection:			
Tons collected per man day	2.2	2.9	+32%
Tons collected per shift	6.1	8.0	+31%
Tons collected per load	2.6	3.6	+59%
Loads collected per man day	0.9	2.2	+144%
Street Cleaning (power sweepers):			
Miles swept/miles in area	3.6	3.9	+8%
Miles swept/broom shift	14.6	13.4	-8%
Snow & Ice Removal:			
Miles plowed per inch snowfall	368	420	+14%
Miles plowed per shift	13	16	+23%
Miles salt spread per inch snowfall	105	733	+598%
Tons of salt spread per inch snowfall	75	967	+1,189%

The measures shown above indicate substantial gains in productivity of almost all direct outputs analyzed. The sanitation department statistics provided particularly useful input measures, such as man days worked, number of truck shifts, etc. These allow more accurate productivity measures to be calculated than is possible with total employment as an input measure. Therefore, the above productivity measures can be regarded with more confidence than those of the previous two case studies.

The productivity measures shown indicate substantial gains in almost all sanitation department activities over the decade. Thus it does not appear that the positive residual value determined by the expenditure analysis is related to a decrease in overall productivity. It is possible that substantial quality increases also occurred which caused the positive residual despite the apparent presence of productivity improvement. In performance of actual analysis, an attempt should be made to determine whether quality changes had, in fact, occurred. This might be related to purchase of new equipment, etc.

Some examples of major elements in the production process of sanitation services are included here as guidelines for the exercise suggested for the case study:

Service: refuse collection. Elements of production process: sanitation crew meets at garage to pick up truck. Truck travels appointed route; crew members leave truck at appointed stops to empty refuse containers into truck and replace empty containers. Full truck goes to incinerator (or landfill) site to dump collected refuse.

Service: street cleaning. Elements of production process: sanitation crew meets at garage to pick up truck and/or manual cleaning equipment. Truck travels appointed route and returns to garage. Manual cleaner follows appointed route; sweeps curb area and puts sweepings into container; returns to designated locations to empty full container.

Service: snow and ice removal. Elements of production process: sanitation crew meets at garage to pick up plows or sanders. Trucks follow appointed routes, either plowing or sanding as they travel. Return to garage at end of shift.

GLOSSARY

Consequences - Results of direct outputs. (See also Final outputs.)

Direct output - The immediate outcome of the production process. When measuring services, this is generally an activity. (See also consequences).

Effectiveness Measures - Effectiveness measures attempt to estimate the success of a particular program or output in reaching desired objectives such as changes in social states.

Efficiency measures - Efficiency measures are concerned with the manner in which resources are combined into final products. (i.e., production involving minimal waste, expense or unnecessary effort).

Externalities - Spillover effects. Consequences of an action that affect parties not directly involved in that action (e.g., air pollution).

Final outputs - Consequences or effects of direct outputs of public sector production (see also direct output).

Input - A resource used in production, (land, labor, capital, raw materials, etc.)

Inverse Indicator - Measures the reverse of desired final output when the latter cannot be quantified. (i.e., when final output is preventive in nature).

Labor intensive - Describes a production process which utilizes a greater proportion of labor than capital (equipment, etc.).

Management-by-objectives - A management method generally used with managerial level employees in which the supervisor and employees meet periodically to jointly establish objectives, evaluate the attainment of previous objectives, and determine methods to increase goal attainment.

Output - The goods and services generated through the production process.

Private sector - Broadly, the private sector coincides with the productive activities owned and operated by private enterprise.

Production - The conversion of physical inputs (land, labor, capital, etc.) into physical outputs (goods and services).

Productivity Bargaining - Formation of collective bargaining agreements which include changes in work rules, etc. Designed to achieve increased productivity and reciprocal worker gains.

Proxy - A substitute, particularly an indicator used to represent an output that cannot be readily quantified.

Public goods - Goods or services produced or provided by the government. In general, citizens have little control over the amount of consumption because these goods or services are not readily divisible. "Pure" public goods are defined as being equally available to all, once provided (e.g., national defense).

Public sector - The government sector of the economy; economic activities performed by various levels of government.

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*Indicates highly suggested readings.